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# USSR Report

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UDC 551.243

## ARCTIC-NORTH ATLANTIC RIFT MEGASYSTEM

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 8, Aug 84  
(manuscript received 15 Feb 84) pp 3-11

SURKOV, V. S., ZHERO, O. G. and SMIRNOV, L. V., Siberian Geology, Geophysics  
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[Abstract] Late in the Paleozoic on the Eurasian and American continents a new continental crust was formed which over several stages of development became highly anisotropic, rigid and quite thick. The new stage of thermal and magmatic effects of the mantle which began at the end of the Paleozoic in the northern segment of the earth caused destruction of the crust on a large scale, manifested as the formation during the Mesozoic and Cenozoic of a number of rift systems, as well as the North Atlantic and Arctic mid-oceanic ridges. These come together to form a single Arctic-North Atlantic rift megasystem. This megasystem includes rift systems in northeastern Europe, the basins of the North, Norway, Barents and Kara Seas, in the western Siberian plate and North America. The component systems are described briefly. The late Paleozoic-Cenozoic stage must be considered a period of appearance of destructive processes involving splitting of the lithosphere into plates and their separation. The structural manifestation of this process is found in the rift zones and mid-oceanic ridges which make up the continuous Arctic-North Atlantic rift megasystem. Subsidence of tremendous areas of the earth and the formation of large megabasins with very thick Mesozoic-Cenozoic deposits and reserves of hydrocarbons are genetically related to this megasystem. Figures 1; references 9: 6 Russian, 3 Western.  
[114-6508]

UDC 551.326.7

## WAVE-DAMPING EFFECT OF FLOATING ICE ALONG SEA COASTAL ZONE

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 5: GEOGRAFIYA in Russian  
No 5, Sep-Oct 84 (manuscript received 22 Dec 81) pp 58-60

POPOV, B. A.

[Abstract] A study is made of the energy balance of water in a strip 1 m wide parallel with a wave ray as it travels a certain distance through a water area with floating ice. It is considered that the dimensions of the ice floes in the direction of the moving wave are less than the wave length. The equations derived indicate that floating ice can fully damp a wave of a considerable wavelength.

The equations presented allow computations of the minimum width of a strip of floating ice capable of damping waves for various initial conditions such as ice characteristics, wave heights and wavelengths. It is also possible to calculate the residual energy of a wave after it passes through with floating ice. References 2: 1 Russian, 1 Western.  
[65-6508]

UDC (55:910.2)(269)

#### ROUND-THE-WORLD ANTARCTIC EXPEDITION

Kiev GEOLOGICHESKIY ZHURNAL in Russian Vol 44, No 4, Jul-Aug 84 pp 138-139

MITIN, L. I. and GOZHIK, P. F.

[Abstract] In December 1982-April 1983 a round-the-world Antarctic expedition was conducted aboard the vessels "Admiral Vladimirskiy" and "Faddey Bellinsgauzen," organized by the Black Sea Fleet Hydrographic Service. Soviet scientists have been studying the Antarctic for 28 years. However, it remains the least known continent. The major scientific program of this expedition was oceanographic, geophysical and hydrographic study of the Antarctic Ocean. Geological studies were also performed on the shelf, its continental slope and surrounding trenches. The studies performed suggest extensive development of ferromanganese nodules in the southern sea, particularly in the Pacific Ocean sector. There is no doubt of the need for continued testing and contouring of areas of ferromanganese nodules.  
[33-6508]

UDC 551.24

#### HISTORY OF OPENING OF EURASIAN BASIN IN ARCTIC

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 275, No 5, Apr 84  
(manuscript received 10 Aug 83) pp 1156-1161

SAVOSTIN, L. A., KARASIK, A. M. and ZONENSHAYN, L. P., Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences, Moscow; Leningrad Branch, Terrestrial Magnetism, Ionosphere and Radio Wave Propagation Institute, USSR Academy of Sciences

[Abstract] The Eurasian Basin of the Arctic occupies the central part of the Arctic Ocean. It extends for a distance of about 2,000 km from the Spitzbergen zone of faults in the west to the shelf of the Laptev Sea in the east, gradually narrowing from 900 to 300 km in that direction. Computations of the position of the pole of instantaneous rotation between the Eurasian and North American plates reveal that it is at a point with the coordinates 59.9°N and 141.2°E. The Eurasian Basin in its entire length is now in a dilatation regime and is characterized by a spreading of the oceanic crust. A study was made to ascertain whether such a situation has always prevailed. It was determined that the onset of active opening of the basin dates back to about 56 million years ago (possibly earlier). After determining the relative position of lithospheric plates at definite times in the geological past it was necessary to ascertain the true trajectories of their movements. Differential or "instantaneous" poles

of rotation were computed describing movements in a selected coordinate system during a definite time interval. The determined parameters of rotation were used in constructing a map of drift lines describing the trajectory of movement of divergent plates and isochronal lines. A series of maps was constructed showing paleogeodynamic reconstructions of the Eurasian Basin and adjacent territories 56, 36 and 20 million years ago. The repeated change in the position of the pole of opening of the Eurasian Basin during the Cenozoic exerted a strong influence on the formation of the structure of northeast Asia and the adjacent Arctic shelf. Figures 2, tables 1; references 14: 6 Russian, 8 Western. [244-5303]

UDC 551.7(985)

#### MAJOR STAGES AND LIMITS OF DEVELOPMENT OF ARCTIC CONTINENTAL MARGIN OF USSR IN NEOGENE

Moscow SOVETSKAYA GEOLOGIYA in Russian No 7, Jul 84 pp 32-41

GRAMBERT, I. S., KOS'KO, M. K., LAZURKIN, V. M., POGREBITSKIY, Yu. Ye., "Sevmorgeologiya" Geological Production Association

[Abstract] The results of paleoformation reconstructions, correlation of folded processes and specifics of the history of orogeny and magmatism during the Neogene reveal large numbers of tectonic movement phases with activity varying at different times and in different areas of the Arctic. This picture of complex tectogenesis is greatly clarified by comparing the areas of movement and related transformations. As a result of the analysis they are interpreted as superimposition of movement in different periods generated by tectonically active systems, the spheres of influence of which intersected in the Arctic regions. Planetary pulsations are manifested as a succession of epochs of active development, relative stabilization and restoration of platform conditions over broad areas. Five epochs of calm are distinguished in the Neogene. If these epochs are considered the beginning of rhythms, the Neogene is divided into 7 great cycles. The second group of periodic processes is related to epochs of folding in mobile bands. A diagram illustrates the active tectonic movements in the Arctic in the Neogene. Four major demarcation lines are distinguished in the history of geological development of the Arctic shelf in the USSR. Each is briefly described. The discrimination of the four great boundaries in the history of geological development of the Arctic continental edge of the USSR in the Neogene is of general theoretical as well as practical significance: these boundaries divide the evolution of the sedimentary cover of the continental margins of the ocean and related history of mineralogeny into major stages of unidirectional transformation. Figure 1; references: 18 Russian. [34-6508]

UDC 551.345:576.3(571.1)

#### FINDING OF HIGHLY MINERALIZED REPEATEDLY VEINED ICE

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA GEOLOGICHESKAYA in Russian  
No 8, Aug 84 (manuscript received 16 Feb 83) pp 129-134

VASIL'CHUK, Yu. K. and TROFIMOV, V. T., Moscow State University

[Abstract] Special studies of the hydrochemical composition of syngenetic repeatedly veined ice samples were undertaken in littoral-marine and lagoon-marine masses of northwest Siberia. Particular attention was given to masses consisting of Holocene lides and primary terraces, as areas with best known genesis. A special method of sampling was developed to produce a more complete idea of the hydrochemical conditions at the time of formation of ice veins. Samples were taken from the vein in a grid over the entire frontal cross-section to determine the regularities of change of composition of the veins both vertically and horizontally. The materials indicate development of highly mineralized repeatedly veined ice within the limits of the cryolithozone. Analysis of salinity can be used not only as a criterion for establishment of cryogenetic vein type, but also in paleoreconstruction of the facial situation of formation of the veins. Broader use of cryohydrochemical studies for geocryologic work is recommended. Figures 3; references: 4 Russian.  
[41-6508]

#### ANTARCTIC GLACIATION, OR WHAT ARE CATASTROPHES IN EARTH'S HISTORY

Moscow ZNANIYE - SILA in Russian No 8, Aug 84 pp 28-30

KVASOV, D., doctor of geographical sciences

[Abstract] Several theories are discussed to explain the glaciation of the Antarctic. The only one which seems to fit other observations from around the world at the same time is that 30 to 35 million years ago Australia moved away from the Antarctic and a cold southern current around Australia and the Antarctic developed, causing eastern Antarctica to be covered by glaciers. Today, South America and Australia have moved away from the Antarctic completely allowing the current generated by the westerly winds in the southern hemisphere to circulate around Antarctica, separating this current from the Pacific current. The cold water now does not flow northward into the tropics as strongly as previously when Antarctica and Australia were connected, and warm currents no longer flow from the tropics around Antarctica. This has resulted in the cooling and glaciation of Antarctica as a whole, and significant warming of the tropics. Figures 3.  
[38-6508]



METEOROLOGY

UDC 551.32

STATE OF GLACIATION OF KIRGIZ ALA-TOO IN FUTURE (EXPERIMENT IN GLACIOLOGICAL PREDICTION)

Leningrad VESTNIK LENINGRADSKOGO UNIVERSITETA: GEOLOGIYA, GEOGRAFIYA  
in Russian No 6, Issue 1, Mar 84 (manuscript received 10 Dec 82) pp 34-43

MAKSIMOV, Ye. V.

[Abstract] The author for many years studied the present-day and ancient glaciation of the Ala-Too Range in Kirgizia. It was found that in addition to the general climatic factor regulating the state of glaciation, there is also a strong tectonic factor which exerts a significant influence on the state of glaciers. The author earlier formulated a theory of mountain glaciation (PROBLEMY OLEDENENIYA ZEMLI I RITMY V PRIRODE, Leningrad, 1972, 295 pages), according to which the glaciers of the Ala-Too Range will continue to decrease in size during the next 6,000 years. During this time the snow boundary should move upward 550 m. For the Ala-Too this is equivalent to the total disappearance of the glaciers. A. V. Shnitnikov, in addition, has formulated a theory of a 1,850-year rhythm of mountain glaciers. All this has been applied in formulating a glaciological prediction for the range for the coming decades and centuries. The prediction for the end of the 20th and 21st centuries is also based on a 22-year rhythm of glacial activity. In conformity to this wave the greatest advance of glaciers occurred in 1975. It can be assumed that during the period 1985-1990 the glaciers will actively retreat. A new activation should be observed in the 1990's with a maximum in about 1997. In the 21st century, against a background of general reduction, advances can be expected in about 2020, 2040 and a little after 2060 and 2080. Figure 3 is a graph of intrasecular stages of Ala-Too glaciers in the past and future. Variations within the framework of intrasecular variability in general are insignificant. Therefore, in the 21st century there should be no substantial changes in water supply of territories irrigated by rivers originating from the glaciers. Eventually negative crustal movements will favor the aridity of climate, and many other such features and phenomena. Stress was on practical application of this knowledge, particularly in relation to tectonics and seismology, means for predicting or preventing various phenomena. [255-5303]



UDC 551.557.23(217.17)

MOISTURE VARIATION IN NORTHERN HEMISPHERE TEMPERATE LATITUDES

Leningrad VESTNIK LENINGRADSKOGO UNIVERSITETA: GEOLOGIYA, GEOGRAFIYA  
in Russian No 6, Issue 1, Mar 84 (manuscript received 15 Feb 83) pp 48-56

MOSOLOVA, G. I. and MUKHINA, N. P.

[Abstract] Multiyear (1891-1959) investigations were made of variations in the precipitation anomalies in the temperate latitudes of the northern hemisphere in the range 70-40°N and 125°W-90°E. Data on precipitation anomalies were used for each 5° in latitude and longitude. A series of regions was defined (European USSR; Western Siberia; Western Europe; North America; Northern Kazakhstan. The period examined was mainly May-June because the yield of agricultural crops is determined by the precipitation occurring in those months. Long-term variations were determined and periods of accumulation of anomalies of the same sign were ascertained. The integral difference curves method was used for this purpose. Normalized integral difference curves were constructed for each of the mentioned regions. Their analysis made it possible to discriminate periods of different duration in these regions with high and low moisture levels. These are given in Table 1. Table 2 gives the in- and out-of phase variations of precipitation anomalies for these regions for five-year intervals, since for agriculture it is important to evaluate precipitation anomalies and the coincidence or noncoincidence of their sign in different regions for each year. It was found that the probability of a simultaneous unfavorable yield in the United States and in the USSR is 8%, and for two years in a row it is 0. The simultaneous case of negative precipitation anomalies in a given year for the European USSR, Western Siberia and the territory of North America is 10-13%. Tables 2; references 7: 6 Russian, 1 Western.  
[255-5303]

UDC 551.553.21(540)

RELATIONSHIP OF INDIAN MONSOON INTENSITY TO TIME OF ONSET

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 5: GEOGRAFIYA in Russian  
No 5, Sep-Oct 84 (manuscript received 15 Feb 84) pp 65-69

FILIPPOVA, M. G.

[Abstract] A study is made of climatic variability of the dates of onset of the Indian monsoon and total annual precipitation. The total precipitation for the year indicates the intensity of summer monsoon circulation, since 75 to 90% of the total annual precipitation in India occurs during the summer monsoon rains. Initial data consisted of long-term series of

observations of the total annual precipitation and time of onset of the monsoon at Bombay. In most cases when the monsoon begins early precipitation is less than normal, when late--greater than normal. If the monsoon begins very early or late, it will not do the same the next year. Both monsoon onset date and total precipitation exhibit synchronous oscillations with a period of two to three years. Fluctuations of monsoon onset date with a period of 4 and 7 years and total precipitation with periods of 4-6 and 11-13 years occur independently of one another. Figures 2, references 10: 5 Russian, 5 Western.  
[65-6508]

#### EL NINO, THE CAPRICIOUS CHILD

Moscow PRIRODA in Russian No 8, Aug 84 pp 65-74

FEDOROV, K. N.

[Abstract] A popularized description of El Nino, the large-scale climatic event in the Pacific Ocean responsible for severe weather anomalies along the west coasts of North and South America in 1982, is presented. Color diagrams illustrate the relationship between ocean currents and prevailing winds producing the anomaly. It is noted that the experts still do not know whether the warming of the ocean water during El Nino causes the fading of the trade winds to be replaced by predominantly western winds, or vice versa. El Nino of 1982-1983 was thoroughly observed and documented, and scientists are now studying the interrelationships, causes and effects of the various phenomena involved. Figures 5, tables 1.  
[5-6508]

UDC 551.465:551.464.621

#### MODELING OF MECHANISM OF POSITIVE FEEDBACK BETWEEN MEAN EARTH SURFACE TEMPERATURE AND ATMOSPHERIC CARBON DIOXIDE IN GEOLOGIC TIME SCALE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 277, No 4, Aug 84  
(manuscript received 5 Dec 83) pp 836-839

MEL'NICHUK, V. I., Leningrad Department, Oceanology Institute imeni P. P. Shirov, USSR Academy of Sciences

[Abstract] Effects are studied which are not directly related to the emission of industrial carbon dioxide gas into the atmosphere but do influence the distribution of CO<sub>2</sub> between the ocean and the atmosphere. An increase in temperature caused by any factor which is constantly active over hundreds of years and a resulting decrease in the solubility of CO<sub>2</sub> in sea water can lead to a transition of excess CO<sub>2</sub> from the ocean into the atmosphere and a

resultant increase in the greenhouse effect. If in the preindustrial period there was equilibrium between  $\text{CO}_2$  in the ocean and in the atmosphere, anthropogenic factors should disrupt this equilibrium. This may have a strong influence on the climate of the earth over a period of several hundred years. After a thousand years, the process of increasing the partial pressure of  $\text{CO}_2$  in the atmosphere should stop, hence the solubility of carbonates will increase and the bonding of  $\text{CO}_2$  in rift zones of the mid-oceanic ridges may increase. The carbonate system of the ocean thus provides feedback comparable in effectiveness to atmospheric mechanisms which should be considered in modeling the climate of future centuries. References 15: 9 Russian, 6 Western.

[30-6508]

OCEANOGRAPHY

UDC 551.501

NUMERICAL EXPERIMENTS WITH SIMPLE MODEL OF OCEAN CLIMATE

Moscow OKEANOLOGIYA in Russian Vol 24, No 3, May-Jun 84  
(manuscript received 30 Aug 82, after revision 15 Mar 83) pp 385-391

VERBITSKIY, M. Ya., Leningrad Section, Oceanology Institute imeni  
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[Abstract] Earlier the author proposed a model of the evolution of glaciation, describing the dynamics of the free surface of an isothermic linearly viscous glacier (DOKL. AN SSSR, Vol 256, No 6, pp 1333-1337, 1981) and later was coauthor of an atmospheric model based on stationary (latitudinally averaged and averaged in the vertical coordinate) equations for the transfer of heat and moisture. The author now describes a simplified model of the ocean to form part of a three-component ocean-atmosphere-glaciers climatic system. The model is formulated as follows. The idealized ocean has the width  $\Lambda + \Lambda'$  and the depth  $H = \text{const}$ , where  $\Lambda$  is the width of the ocean,  $\Lambda' \ll \Lambda$  is the width of the western boundary layer in which the transfer of heat and mass occurs in the direction from the equator to the poles. Vertically the ocean is divided into two regions (layer of seasonal and main thermocline with the depth  $h = \text{const}$  and abyssal depths). The western boundary layer is discriminated only in the upper part of the ocean. The equations of hydrothermodynamics are written for the ocean outside the equatorial region, for the Ekman and coastal boundary layers in geostrophic, quasistatic and Boussinesq approximations on the assumption that sea water density is dependent only on temperature. The model is used in computing the present-day temperature regime of the ocean. The sensitivity of the model to changes in the parameters of the model is evaluated. The mean temperature of the ocean surface is slightly dependent on the parameters of the problem, whereas the temperature of the deep waters is extremely sensitive to these changes. Figures 3, tables 4; references 10: 4 Russian, 6 Western.  
[258-5303]

UDC 551.466

NUMERICAL INVESTIGATION OF EVOLUTION OF ENERGY SPECTRUM OF SLIGHTLY NON-LINEAR ROSSBY WAVES

Moscow OKEANOLOGIYA in Russian Vol 24, No 3, May-Jun 84  
(manuscript received 19 Jul 83) pp 373-384

REZNIK, G. M. and SOOMERE, T. E., Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences, Moscow

[Abstract] Nonlinear effects and the  $\beta$ -effect play an extremely important role in the dynamics of oceanic and atmospheric movements. Since a full study of the joint influence of these two factors is exceedingly difficult, solution of the problem requires use of simple model physical systems. Accordingly, the authors employed a very simple system which takes into account nonlinearity, the  $\beta$ -effect and a large number of wave harmonics: a system of weakly interacting Rossby waves with random amplitudes on the  $\beta$ -plane in a barotropic ocean of constant depth. The behavior of such a system is described by a kinetic equation for the spectral density of energy  $F = F(\chi, T)$ . With this as a point of departure, it was found that: nonlinear interactions lead to an intensification of the zonal component of a current and to an isotropic distribution of energy for wave vectors adequately distant from a meridional direction; initially the asymmetric spectrum tends with time to become symmetric due to interaction with the almost zonal component of the current. The rates of energy transfer in absolute value and for different azimuths of the wave vectors are compared. Energy transfer to wave vectors of an almost meridional direction means the existence of an energy flow from waves of a relatively great frequency to low frequency waves (from the component of movement changing rapidly with time to the slowly changing component). This phenomenon is generated only by the  $\beta$ -effect and nonlinearity and is of fundamental importance because it is evidence of the possibility of energy transfer from synoptic eddies to mean movements. Figures 7; references 11: 6 Russian, 5 Western.  
[258-5303]



UDC 534.22(S88.8)

PULSED-CYCLIC INSTRUMENT FOR SPEED-OF-SOUND MEASUREMENT (FOR HYDROPHYSICAL  
WORK AT SEA)

Moscow OKEANOLOGIYA in Russian Vol 24, No 3, May-Jun 84  
(manuscript received 29 Sep 82) pp 539-543

POPOV, Ye. D., Southern Branch, Oceanology Institute imeni P. P. Shirshov,  
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[Abstract] Velocimeters now currently in use are encumbered by various shortcomings: complex design of transducer heads with exposed piezoelements subject to hydrostatic pressure, imperfection of the thermobarocompensation for the base, poor system for attachment of the heads, inefficient sealing around the electrical lead-ins and large size. A new instrument for measuring the speed of sound has been developed in which the design of the mechano-acoustical part is free of separately placed heads, their attachment system, the need for compensating hydrostatic pressure on the piezoelement and sealing of the electrical lead-ins by the introduction of a protective membrane into the acoustic part. The membrane is fabricated in the form of a plano-concave lens. The concavity is conical. The generatrix angle for the conical surface is computed on the basis of the laws of reflection and refraction of acoustic waves at the interface of two media. An ultrasonic pulse from an emitting piezoelectric plate passes through this membrane, being refracted at the membrane-medium interface, is incident on a reflector and then is returned to the membrane. Being refracted again in the membrane, the pulse arrives at a receiving piezoelement. The double refraction of the acoustic ray in the membrane eliminates the need for special orientation of the piezoelements and makes it possible to position them in the same plane. The horizontal positioning of the piezoelements under the membrane in the body of the velocimeter base simplifies the system of lead-ins and due to the possible bringing of the piezoelements together makes it possible to reduce the diameter of the membrane. The instrument has a length of 40 mm and a diameter of 29 mm; the mean length of the base is 15 mm; threshold response is  $0.1 \cdot 10^{-3} \text{ m} \cdot \text{sec}^{-1}$ . The heads have been checked at a pressure  $> 10^8 \text{ Pa}$ . Figures 2; references 10: 7 Russian, 3 Western.  
[258-5303]

UDC 597.5:577.95(262.5)

WINTER ICHTHYOPLANKTON OF SOUTHWESTERN BLACK SEA

Moscow OKEANOLOGIYA in Russian Vol 24, No 3, May-Jun 84  
(manuscript received 5 Nov 82, after revision 30 May 83) pp 519-524

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[Abstract] Ichthyoplankton was collected in the southwestern and southeastern parts of the Black Sea by the "Professor Shtokman" during the period November-December 1980. The main work region was the southwestern part of the sea (indicated on two maps). The material was collected from the surface and from a depth of 0-50 and 50-100 m. Catches were made over a period of 10 minutes while the ship was at drift. The number of eggs and larvae was counted per 1 m<sup>2</sup> in a water column in the layers 0-50 m and 50-100 m. The material was collected in winter, a season generally unfavorable for a qualitative evaluation because the ichthyoplankton is characterized by a low number and small diversity of species. The distribution of eggs and larvae was determined in zones: neritic, to depths of 100 m; zone below the continental slope at depths from 100 to 1,400 m; deep-water zone, including transition between continental slope and abyssal depths. Three species were represented in the collection: juveniles of *Blennius tentacularis* Brunnich, eggs and larvae of *Merlangus merlangus euxinus* (Nordmann) and *Sprattus sprattus sprattus* (L) (Risso). The numbers of ichthyoplankton were low, a result of a low intensity of spawning of Black Sea whiting at this time. Eggs and larvae of sprat constituted 99.2% of the ichthyoplankton collection. Sprat always multiplies in cold water and mass spawning occurs during the period December-March. Spawning in the first 10-day period of December began from the surface horizon of the neritic zone; then the spawning sprat descent into deeper layers so that in the second 10-day period in December the greatest number of eggs is no longer at the surface, but in the layer 50-100 m. The regions of most intensive spawning were the open part of the Gulf of Burgas and the northwestern part of the Black Sea where a strong influence is exerted by Danube runoff (these are the best feeding grounds for sprat). Figures 2, tables 4: references: 9 Russian.  
[258-5303]

UDC 998.595.384.12

# REFINING SCHEME OF VERTICAL ZONALITY OF MARINE BOTTOM FAUNA

Moscow OKEANOLOGIYA in Russian Vol 24, No 3, May-Jun 84

(manuscript received 23 Feb 82, after revision 23 Aug 83) pp 515-518

BURUKOVSKIY, R. N., Atlantic Scientific Research Institute of Fishing and Oceanography, Kaliningrad

[Abstract] The existing scheme for the vertical zonality of fauna has been made more precise on the basis of the results of study of the bathymetric distribution of shrimp species along the coast of West Africa. Specimens were collected with the "Khek-4M" bottom trawl which with a trawling rate of 4 knots has a vertical span of about 6 m and a horizontal span of about 15 m. The volume of material was 631 catches at depths of 13-1,230 m and 96 species of shrimp were encountered in the samples. The range of investigated depths took in virtually the entire shelf and the upper part of the continental slope to the boundary between the upper and lower bathyal. This corresponds to two subdivisions of the usually accepted scheme for the vertical zonality of oceanic fauna (G. M. Belyayev, et al., DOKL. AN SSSR, Vol 129, pp 658-661, 1959; O. K. Leont'yev, DNO OKEANA, Moscow, Mysl', 1968, 319 pages): sublittoral (from 0 to 200 m) and transition horizon (from 200 to 500-1,000 m). The investigated region was virtually the entire western coast of Africa (subtropical, tropical and equatorial climatic zones). All the shrimps fell into four taxonomic divisions, each associated with a particular depth range: shelf or sublittoral; outer edge of shelf; upper part of continental slope; lower part of continental slope. The refined scheme of vertical zonality of fauna is as follows: 0-70-100 m--sublittoral within the limits of the surface and transition layers of the surface structural zone of waters; 50-100-350-550 m--edge of shelf within limits of boundary layer between the surface and intermediate structural zones of waters; 350-500-1,000 m--upper part of slope within limits of the intermediate structural zone of waters. It is stressed that the proposed supplement to the scheme of vertical zonality is applicable only for subtropical, tropical and equatorial regions. Tables 1; references 19: 16 Russian, 3 Western.  
[258-5303]

UDC 577.524.12(268)

COPEPODS AETIDEIDAE (COPEPODA, CALANOIDA) IN EASTERN SECTOR OF CENTRAL ARCTIC BASIN

Moscow OKEANOLOGIYA in Russian Vol 24, No 3, May-Jun 84  
(manuscript received 5 Jan 83) pp 511-514

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[Abstract] Few studies have been devoted to study of the Calanoida in the central part of the Arctic Basin. The author analyzed 49 samples from 13 stations occupied between 80-86°N along the meridian from the Novosibirskiye Islands to the pole of the drifting station "SP-19." Samples were taken in the layers 0-50 m, 50-200 m, 200-750 m and 750 m to the bottom. Eight species of Aetideidae were encountered in the processed samples. Among these the bipolar species *P. batillipa* and *P. elongata* were discovered for the first time in the central part of the Arctic Basin. Both the latter are abyssal representatives of the Aetideidae family. It is postulated that the bipolar range of *P. batillipa* and *P. elongata* was formed earlier than the Late Pliocene when a strong cooling occurred in the northern hemisphere. The small morphological differences in the Arctic and Antarctic populations of the two species also are indicative of a recent isolation of the Arctic part of the range. Diagrams of *Pseudochirella elongata* are given, accompanied by a table which gives data on the frequency of occurrence of different species of Aetideidae in the eastern sector of the central part of the Arctic Basin. Figures 2, tables 1; references 16: 7 Russian, 9 Western.  
[258-5303]

UDC 577.524.12:577.48(269/267)

DISTRIBUTION OF EGGS AND LARVAE AND FUNCTIONAL STRUCTURE OF EUPHASIA SUPERBA DANA RANGE

Moscow OKEANOLOGIYA in Russian Vol 24, No 3, May-Jun 84  
(manuscript received 19 Jan 83) pp 505-510

SAMYSHEV, E. Z., Azov-Black Sea Scientific Research Institute of Marine Fishing and Oceanography, Kerch

[Abstract] There is much that has remained unclear concerning the life cycle of *Euphausia superba* Dana. Specialists of the Sea of Azov-Black Sea Scientific Research Institute of Marine Fishing and Oceanography investigated this problem during the period 1977-1982 with emphasis on the following: clarification of the nature of distribution of eggs and larva during



regularly conducted surveys intersecting a considerable part of its range in the Indian Ocean sector of Antarctica and on this basis drew conclusions concerning the behavior and reproduction of *E. superba*. The investigated area was within the limits 60-85°E and 58°S. Runs were made each 5° in longitude with stations being occupied each 1° in latitude. Plankton was sampled from the standard horizons 0-25, 25-50, 50-100, 100-200, 200-500, 500-1,000 and 1,000-2,000 m. Observations of adult *E. superba* were also made. The data from three representative surveys were analyzed. In the Indian Ocean sector of Antarctica it was found that the range of *E. superba* does not extend beyond 58°S. Stable dense concentrations of the adult part of the population are found in coastal zones with a deeply incised shoreline. The percentage of spawning females at any one time does not exceed 4-5%, the spawning season being very drawn out. Spawning is possible everywhere within the investigated area, but effective reproduction of the populations is ensured only in shallow-water areas with a deeply cut shoreline isolated from the open ocean by a system of currents preventing the transport of eggs into deep-water sectors. Figures 4; references 8: 3 Russian, 5 Western. [258-5303]

UDC 551.468

SPECIAL FEATURES OF COMPUTATIONS OF VERTICAL DISTRIBUTION OF CONCENTRATION OF SUSPENDED SEDIMENTS UNDER MARINE CONDITIONS

Moscow OKEANOLOGIYA in Russian Vol 24, No 3, May-Jun 84  
(manuscript received 10 Feb 83, after revision 17 May 83) pp 498-504

KOS'YAN, R. D., Southern Branch, Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences, Gelendzhik

[Abstract] When computing the discharge of sediments in the coastal zone of the sea it is essential that the distribution of the concentration of suspended sediment be calculated correctly for a definite class of waves. In an earlier article (R. D. Kos'yan, et al., OKEANOLOGIYA, Vol 21, No 5, pp 865-872, 1981) a semiempirical model was given for the vertical distribution of the relative concentration of suspended sediments. That model, based on modern physical concepts, better than any other describes the concentration profile. However, the model was checked only on the basis of laboratory results. Accordingly, on the basis of in situ observations made at different times, an effort was made to find the conditions under which this dependence can be used for computations in the shore zone of the sea and restrictions on its use were determined. The equation for the profile of the concentration of sediments derived in the above-mentioned article is subjected to a number of tests for a variety of variables. It was found that this fundamental equation satisfactorily describes the vertical profile of concentration of suspended sandy sediments with a mean grain diameter from 0.05 to 0.5 mm. The equation can be used in practical computations in the zone of transformation and insignificant dissipation of wave energy



in the entire thickness of the flow, except for the thin bottom layer. In computing the profile the best results can be attained by substituting into the formula the values of wave characteristics corresponding to the maximum spectral density. Figures 4, tables 1; references 18: 13 Russian, 5 Western.  
[258-5303]

UDC 551.241(265/266)

#### ABSOLUTE MOVEMENT OF PACIFIC OCEAN PLATE DURING LAST 120 MILLION YEARS

Moscow OKEANOLOGIYA in Russian Vol 24, No 3, May-Jun 84  
(manuscript received 30 Sep 83) pp 484-492

KONONOV, M. V., Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences, Moscow

[Abstract] The oceanic Pacific Ocean plate is an ideal object for comparison of movement of a plate in an absolute coordinate system using three independent sources: paleomagnetic data, paleoclimatic data and the trajectories of hot points. Determinations were made of three paleomagnetic poles of the Pacific Ocean plate for 120, 100 and 80 million years. The trajectory of apparent migration of the Pacific Ocean plate pole was determined. A map of the Pacific Ocean paleoequators was compiled on the basis of data on the time of passage of abyssal drilling borehole points through the equatorial region. (Figure 1 is a series of maps comparing paleomagnetic and paleoclimatic data; Fig 2 is a diagram comparing paleomagnetic data with data on hot point trajectories; Fig 3 is a map showing the absolute movement of the Pacific Ocean plate during the last 120 million years.) It was found that latitudinal drift according to paleomagnetic data is  $42^\circ$  for 120 million years and  $24^\circ$  for 80 million years with a mean rate of 3.3-3.9 cm/year, and according to paleoclimatic data  $36^\circ$  for 100 million years with a rate of 3.6 cm/year. In the interval 120-80 million years there was a jump in the rate from 3.6 to 5 cm/year. The trajectories of hot points reveal two stages in restructuring of translational motion of the plate between the intervals 125-70 and 70-43 million years from WNW to northerly movement and between the intervals 70-43 and 43-0 million years from northerly to northwesterly movement. Data obtained from independent sources indicate that during the last 125 million years the Pacific Ocean plate has moved about 9,000 km in a northwesterly direction. Figures 3, tables 2; references 29: 3 Russian, 26 Western.  
[258-5303]

UDC 550.834

DETERMINING DEGREE OF PARTIAL MELTING OF ASTHENOSPHERE FROM SEISMIC DATA

Moscow OKEANOLOGIYA in Russian Vol 24, No 3, May-Jun 84

(manuscript received 13 June 83) pp 477-483

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[Abstract] The nature of the zone of reduced velocities of seismic waves at depths of about 50-150 km beneath the ocean floor, a phenomenon which might be explained in several ways, is examined in detail, although the hypothesis of partial melting is deemed to be most probable. An effort is made to ascertain the percentage volume of the molten phase in the total volume of asthenospheric matter. The problem is examined using a model formulated on the assumption that the oceanic lithosphere is formed due to the crystallization of molten upper mantle matter and movement of lithospheric plates from the rift zones to the oceanic basins. The lithosphere model used in the study is illustrated in Fig 1. The model is limited to the age interval  $> 60$  million years. Close attention was given to the change in the Poisson coefficient as determined from seismic data. As shown in Fig 2, for example, at depths of 70-90 km there is a considerable change in the coefficient, this corresponding to the lithosphere-asthenosphere boundary. The considerable change in this parameter may be evidence of presence of melt in the asthenosphere. The ratio of  $V_p$  and  $V_s$  changes at these depths, increasing by a factor of 1.030, which would indicate presence of about 3% melt beneath the considered parts of the lithosphere. Data on the distribution of conductivity in the mantle are an independent source of information on presence of melt and at temperatures 1100-1300°C the conductivity would be such as to explain partial melting. All of the mentioned data are consistent with partial melting. The volumetric percentage of melt would be a few percent under a lithosphere with an age greater than 60 million years. Figures 2, tables 2; references 36: 19 Russian, 17 Western.  
[258-5303]

UDC 551.46.09/628.5

DETERMINING ADSORPTION OF SURFACE-ACTIVE SUBSTANCES BY SEA BOTTOM DEPOSITS

Moscow OKEANOLOGIYA in Russian Vol 24, No 3, May-Jun 84

(manuscript received 6 Apr 82, after revision 2 Dec 82) pp 464-469

NESTEROVA, M. P., MOCHALOVA, O. S. and ANTONOVA, N. M.,

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[Abstract] Since large quantities of surface-active substances are now entering the ocean it has become essential to carry out systematic monitoring of their content in sea water and bottom deposits. Data have already been published indicating an accumulation of these substances in bottom deposits. The authors therefore made a quantitative determination of the adsorption of surface-active substances produced in the United States and in the Soviet Union by bottom deposits of different fractional composition in sea water with different salinities. Adsorption by bottom deposits was determined in the laboratory by the precipitation of turbid bottom deposits in fresh and sea water. In the modeling use was made of Baltic Sea sediments of two types: sandy alluvium of the Vistula and silty deposits of the Gulf of Riga. Spectrophotometric analyses were made and revealed a number of regularities in the adsorption of dispersing agents by bottom deposits. It was found that bottom sediments are capable of sorbing surface-active substances from both fresh and sea water. The combination of such factors as the salinity of sea water and the granulometric composition of the sediment changes the relative degree of adsorption of dispersing agents in a wide range from several percent to an almost complete elimination of surface-active substances from solution. With transition from fresh to saline water there can be a marked change in the content of dissolved surface-active agents in water due to adsorption processes. This is particularly necessary to take into account in studying the pollution of water bodies by these substances at the boundary of hydrochemical barriers (when sea and river waters mix). The adsorption of surface-active substances is not a process of self-purification of water bodies; it is a different form of pollution. Figures 4, tables 2; references: 10 Russian.  
[258-5303]

UDC 551.464(267)

SOME BIOCHEMICAL CHARACTERISTICS OF BOTTOM WATERS IN NORTHWESTERN INDIAN OCEAN

Moscow OKEANOLOGIYA in Russian Vol 24, No 3, May-Jun 84  
(manuscript received 24 May 82) pp 460-463

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[Abstract] The content of ATP and carbamide (urea) in bottom waters was determined on the 22nd voyage of the "Akademik Kurchatov" (March-July 1976) in the southwestern part of the Indian Ocean. Water samples were taken at a distance of 3-4 m from the bottom using a special bottom bathometer with a piston compensator and also an ordinary bathometer 1 m above it. Laboratory measurements were made of ATP, carbamide and dissolved organic carbon (C<sub>org</sub>). ATP as an index of living matter was determined by the Holm-Hansen method; carbamide was detected by the Breinek method; organic carbon was ascertained by the Lyutsarev low-background method for its analysis in water. The various research methods used along the vessel's entire track yielded data (summarized in a table) for a number of stations (plotted on a map). These data revealed that in bottom waters the concentrations of ATP, carbamide and dissolved organic carbon are considerable, sometimes several times greater than in the photic and surface layers of the ocean. The determined biochemical characteristics in the water bottom layer are of great importance in evaluating the state of the water medium. A significant finding was that the most active life (maximum ATP content) was in the bottom waters in the region of faults in the rift zones in the ocean where increased concentrations of gases were found at the same time. Under these conditions a population of micro-organisms with a chemolithoautotrophic type of metabolism developed. Thus, active life exists at the boundary between the ocean and bottom at ocean depths as great as 5 km. Its intensity is hypothetically attributable to processes transpiring in the lithosphere, including the formation of gases, and to a lesser degree to the content of organic matter in the above-lying water layer. Biochemical research is an additional means for evaluating the possibility of presence of petroleum and gas and should be combined with gasometric determinations. This will cast further light on the processes involved in the formation of petroleum and gas and will assist in their detection. Figures 1, tables 1; references 9: 7 Russian, 2 Western.  
[258-5303]

UDC 581.526.325:551.464

POSSIBLE ROLE OF OCEAN BIOTA IN GLOBAL CARBON BALANCE

Moscow OKEANOLOGIYA in Russian Vol 24, No 3, May-Jun 84  
(manuscript received 15 Sep 81, after revision 1 Mar 83) pp 453-459

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[Abstract] The quantity of phytoplankton production in the ocean outside the zone of its synthesis was estimated. An analysis revealed that an increase in the atmospheric concentration of carbon dioxide can result in an almost proportional increase in primary production due to an increase in the fraction of extracellular excretions. The excess of primary production forming in this case is not oxidized in the ocean depths and should increase the quantity of dissolved organic matter in the ocean. Any possible intensification in photosynthesis as a result of an increase in the surface concentration of  $\text{CO}_2$  should result in a net flow of  $\text{CO}_2$  from the ocean into the atmosphere and the accumulation of organic matter in the ocean. With a decrease in  $[\text{CO}_2]_{\text{atm}}$  the production of phytoplankton should drop and heterotrophs can compensate the insufficiency of production by the oxidation of dissolved organic matter, which should transform the dissolved organic matter into atmospheric  $\text{CO}_2$ . When life is present in the ocean dissolved organic substances can perform the function of an organic buffer evening-out  $\text{CO}_2$  fluctuations in the atmosphere. In this case the oxidation of dissolved organic matter and the emission of  $\text{CO}_2$  into the atmosphere should occur considerably more slowly than the synthesis of dissolved organic matter and  $\text{CO}_2$  absorption from the atmosphere. Available data on oceanic dissolved organic matter are consistent with a possible increase in the quantity of dissolved organic matter by 10% during the last 20 years, but the same quantity of carbon could be released into the atmosphere during this same time due to a reduction in forest cover. Accordingly, the total global balance of carbon remains unchanged. Figures 1; references 11: 1 Russian, 10 Western. [258-5303]



UDC 551.463.5;547.979.7

STRUCTURE OF PHOTIC LAYER OF ATLANTIC OCEAN WATERS IN CONTINENTAL SLOPE  
REGION OF GUINEA COAST (BASED ON DATA FROM CHEMICAL, BIOLOGICAL AND OPTICAL  
OBSERVATIONS)

Moscow OKEANOLOGIYA in Russian Vol 24, No 3, May-Jun 84  
(manuscript received 28 June, after revision 7 Feb 83) pp 445-452

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of Sciences, Sevastopol

[Abstract] Synchronous measurements of biological, chemical and optical characteristics of waters in the continental slope zone along the coast of Guinea were made during the 40th cruise of the "Mikhail Lomonosov." Measurements were made with a sounding transparency meter and remotely controlled bathometers, making it possible to take water samples from 10-16 horizons. These observations yielded great volumes of information on the distribution of the light extinction index, chlorophyll content, suspended organic carbon, total phosphorus in suspended matter and the concentration of phosphates and dissolved oxygen. Measurements were made during the period 16 November-6 December 1980 at 36 stations, of which 12 were on the shelf and 24 on the slope. A comparison of the results revealed a high correlation between the structure of the fields of all these parameters on the continental slope. Data for one of the latitudinal runs (9°30'N) are examined as an example. On the continental slope the structure of waters is determined primarily by interaction of constant currents and bottom relief, leading to the appearance of a coastal upwelling. In the uppermost surface layer this gives rise to a mixed, quite uniform layer, poor in biogens with relatively little phytoplankton. Deeper, in the seasonal thermocline, is the most turbid and biologically productive layer, the latter being attributable to the receipt of upwelling waters, as well as runoff of suspended matter from the shelf. The current in these layers is directed toward the open ocean. Because of interaction between the upwelling and bottom relief over the sharp boundary between the slope and shelf an eddy develops with a horizontal axis which destroys the horizontal uniformity of the waters, forming local zones of upwelling and subsidence and resulting in a maximum phytoplankton content in the layer. Figures 3, tables 1; references 10: 6 Russian, 4 Western.  
[258-5303]

UDC 551.462(266)

BIOGEOCHEMICAL COMPOSITION OF BOTTOM SEDIMENTS OF PERUVIAN CONTINENTAL SLOPE  
AND SHELF

Moscow OKEANOLOGIYA in Russian Vol 24, No 3, May-Jun 84  
(manuscript received 25 Feb 83, after revision 17 Jun 83) pp 440-444

BORDOVSKIY, O. K. and AKHMET'YEVA, Ye. A., Oceanology Institute imeni  
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[Abstract] The data collected during the 34th cruise of the "Akademik Kurchatov" on the continental shelf and slope of Peru (together with data obtained earlier) were used in an analysis of the upper active layer of bottom sediments, ooze waters and bottom waters. Alk, pH, Eh, biogenous elements and  $C_{org}$  were determined. The data indicate substantial differences in the chemical composition of the sediments, their liquid phase and bottom waters, indicating a nonequilibrium of this system and the possibility of chemical, primarily diffusional exchange. This nonequilibrium of the system is governed primarily by the processes of decomposition of organic matter in bottom sediments. Biochemical studies of the organic matter in sediments revealed the presence of proteins, carbohydrates and lipids in concentrations four orders of magnitude greater than in water. Proteins are the most important component. A significant role is played by living organisms (especially bacteria) in the transformation of the organic matter in sediments. All these components were found in the liquid phase of sediments but their total concentration is less by a factor of 2,500 than their mean content in sediments and only greater by a factor of 13 than in the bottom water. The liquid phase of sediments is far richer in organic matter than is water. In bottom waters there was a predominance of carbohydrates. Therefore, the biochemical composition of sediments, their liquid phase and bottom water differs considerably. Tables 2; references 9: 8 Russian, 1 Western.  
[258-5303]

UDC 551.465.16.(265/266)

# MIXING OF OYASHIO AND KUROSHIO WATERS ON POLAR FRONT

Moscow OKEANOLOGIYA in Russian Vol 24, No 3, May-Jun 84  
(manuscript received 11 Oct 82) pp 421-426

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imeni P. P. Shirshov, USSR Academy of Sciences, Kaliningrad; Acoustics  
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[Abstract] A hydrological section was run across the polar (subarctic) frontal zone along 160°E between 35 and 46°N by the "Dmitriy Mendeleev" during the period 14-21 September 1981. The observed distribution of hydrological characteristics confirmed the two-front structure of this zone with the northern front at about 45° and the southern front at about 35°N (there is also a secondary northern front near 41°N). Analysis of temperature T, salinity S, nominal density  $\sigma_t$ , oxygen O<sub>2</sub>, silicon Si and speed of sound, as well as the T,S-; T, O<sub>2</sub>-; T, Si- and T, c-curves revealed presence of the following regions. The region of a subarctic structure of waters of the northern front (Oyashio); the zone of mixing of Kuroshio and Oyashio waters between the northern and secondary northern fronts; the zone of mixing of Kuroshio and Oyashio waters between the secondary northern front and the southern front; the region of a subtropical structure of waters (northern branch of Kuroshio) along 35°N. The highest content of water with a subarctic structure (+50%) is in the northern part of the section between 45 and 41°N. The most intensive zone of mixing of Kuroshio and Oyashio waters on the polar front is the zone of the secondary northern front where these waters are encountered with a high percentage content (50-60%). The T,S characteristics of these waters explain the mixing of the three water masses: Kuroshio, Oyashio and deep. The most intensive mixing zone has an extent of only 15 miles; the distribution of the mixing waters has a complex nature due to the influence of eddies constantly present in the entire broad frontal zone. Figures 3; references: 2 Russian.  
[258-5303]

UDC 551.465(262)

FORMING OF MEDITERRANEAN SEA INTERMEDIATE WATERS IN RHODES CYCLONIC CIRCULATION

Moscow OKEANOLOGIYA in Russian Vol 24, No 3, May-Jun 84  
(manuscript received 24 Jun 82, after revision 4 Oct 83) pp 417-420

OVCHINNIKOV, I. M. and PLAKHIN, Ye. A., Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences, Moscow

[Abstract] In a study of the formation of intermediate Mediterranean waters the authors investigated the center of the Rhodes cyclonic circulation. Computations were made for a  $1^\circ$  grid square using a model of a non-stationary thermohaline structure of the upper layer. The formulation of the problem and the model algorithms used were published earlier. With stipulated initial and boundary conditions and a mean state the problem contains three parameters: depth interval  $\Delta z$ , time interval  $\Delta t$  and effective coefficient of vertical turbulent exchange  $A_z$ . Figure 1 shows the mean distribution of temperature and salinity with depth; Fig 2 shows the seasonal variation of deviations of temperature and salinity at the sea surface. A total of 37 temperature and salinity profiles were obtained. Actual observations from research ships were made in March 1977 and February 1982. It was confirmed that in late February-early March convective currents here are propagated from the surface to a depth of not less than 400 m and form the intermediate (Levantine) water mass of the Mediterranean Sea. In individual seasons with an extremely cold winter (surface water temperature  $< 14^\circ\text{C}$ ) convective mixing can be propagated to the bottom and participate in the formation of deep waters in the eastern basin. Figures 4; references 6: 5 Russian, 1 Western.  
[258-5303]

UDC 551.464(262.5)

FORMING OF PRESENT-DAY BLACK SEA SALINITY FIELD

Moscow OKEANOLOGIYA in Russian Vol 24, No 3, May-Jun 84  
(manuscript received 28 Jul 82) pp 410-416

BOGUSLAVSKIY, S. G. and KOTOVSHCHIKOV, B. B., Marine Hydrophysical Institute, Ukrainian Academy of Sciences, Sevastopol

[Abstract] The article gives a mathematical model of the process of Black Sea salinization from the end of the last glaciation and the formation of the present-day vertical distribution of salinity. The model is needed for computations and predictions of changes in the salinity field at the present stage, taking into account the influence of natural and anthropogenic factors. It is postulated that 7,000-9,000 years ago the Black Sea was a



closed fresh-water body not linked to the Mediterranean Basin. Its salinity began to be formed when the highly saline waters of the Sea of Marmora, penetrating through the Bosphorus and sinking, began to supply salt to the bottom layer of the Black Sea, which by means of turbulent diffusion was propagated into higher horizons. The upper Bosphorus Current greatly freshened the surface waters and was also an important factor in forming the vertical distribution of salinity. The mathematical model was formulated using the nonlinear diffusion equation, taking into account the dependence of the exchange coefficient on stability. The time period from zero salinity to the setting-in of the present-day distribution was found to be  $\sim 5,000$  years. The present-day distribution of salinity was found on the assumption that the discharge of the upper and lower currents and accordingly the intensity of the upper and lower salinity sources were constant in time. But it appears that in the second half of this century, under the influence of man's economic activity, the runoff of rivers into the Black Sea is dropping and this will result in a decrease in the intensity of the upper freshening source; it can be assumed that in 30 years the runoff of rivers will be reduced by 30%. Salinity was computed at time intervals of 1 month for 22 horizons; the results of a numerical analysis of the model are given in Fig 2. It is to be expected that an evening-out of the vertical distribution of temperature will occur and there will be an increase in the isothermic layer. This circumstance, together with an evening-out of the salinity distribution, will also favor a broadening of the zone of convective mixing and an increase in heat accumulation in the active layer of the sea during spring-summer heating. A reduction in continental runoff will lead to an increase in the ameliorating influence of the Black Sea on the climate of the coastal zone. Figures 2; references: 7 Russian. [258-5303]

UDC 551.465

# REGIONS OF PROPAGATION OF SHORT-WAVE PERTURBATIONS IN SPHERICAL LAYER OF ROTATING FLUID

Moscow OKEANOLOGIYA in Russian Vol 24, No 3, May-Jun 84

(manuscript received 18 May 82, after revision 27 Apr 83) pp 392-397

KIVMAN, G. A. and MASLOVA, N. B., Leningrad Section, Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences

[Abstract] Small free oscillations of a rotating stratified fluid were investigated. It is demonstrated that the spectrum of free oscillations contains a segment  $[-\alpha, \alpha]$  and is contained in the segment  $[-\beta, \beta]$ . Therefore, if the spectrum of free oscillations is discrete, the set of characteristic frequencies is dense in the segment  $[-\alpha, \alpha]$ . In investigating a homogeneous fluid Greenspan formulated the hypothesis that the set of characteristic frequencies is dense in  $[-\Omega, \Omega]$  for any regions. The



foregoing assertion represents a refinement and generalization of the Greenspan hypothesis. The assumption of spectral discreteness is important because regions can exist for which the spectrum is not discrete. Developing the problem further, the regions of propagation of short waves in a thin spherical layer are described. This is followed by evaluations of the accuracy of their description in the traditional approximation. It is shown that the frequencies of free oscillations of a stratified fluid satisfy the condition  $|\sigma| \leq \frac{1}{2}[1 + (1 + 4 \max N^2)^{\frac{1}{2}}]$ . If the spectrum is discrete, the set of characteristic frequencies is dense in the segment  $[-\alpha, \alpha]$ , where  $\alpha = (1 + \max N^2)^{\frac{1}{2}}$ . The density of the characteristic frequencies is related for the most part to the presence of short waves (called "pathological" waves by K. Stewartson, et al., J. FLUID. MECH., Vol 35, No 4, pp 759-773, 1969). At low frequencies the short waves are localized. The structure of the regions of their propagation is essentially dependent on stratification. In the case of a poorly stratified fluid the traditional approximation filters waves in the equatorial region. Some of the considered short waves evidently attenuate rapidly, but any examination of their rate of attenuation requires allowance for viscous dissipation (not taken into account in this article).  
References 8: 6 Russian, 2 Western.  
[258-5303]

UDC 528.563

#### ERRORS IN DETERMINING GRADUATION OF SEA GRAVIMETER ELASTIC SYSTEM DUE TO HORIZONTAL PENDULUM MOTION

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEODEZIYA I AEROFOTOS"YEMKA in Russian No 2, Mar-Apr 84 (manuscript received 7 May 81) pp 116-120

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[Abstract] An increase in the accuracy of gravimetric surveys requires allowance for those factors whose influence has hitherto been neglected. In sea gravimeters the sensor used is an elastic system with a horizontal torsion fiber; in making computations allowance is made for only one degree of freedom of the pendulum: rotation about the axis of the fibers in the vertical plane. However, with tilting of the gravimeter in the plane of the fibers the pendulum is deflected in the "fiber-pendulum" plane. The value of this angle in existing elastic systems attains 3-5 minutes of angle with a tilt of the fibers by  $4^\circ$ . Particular attention is given to two factors exerting an influence on gravimeter readings: change of tension in the fibers and change in pendulum position. Pertinent equations are derived for determining the influence of these errors when using the tilt calibration method. It is shown that the principal source of error in determining gravimeter graduation by the tilt method is the change of tension in the fibers due to horizontal motion of the pendulum. This can be eliminated by unloading the fiber in an axial direction. Figures 2, tables 1; references: 4 Russian.  
[236-5303]

UDC 528:550.837.7

METHODOLOGICAL ERRORS IN MEASURING OCEAN SURFACE TEMPERATURE WITH IR  
RADIOMETER

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEODEZIYA I AEROFOTOS"YEMKA  
in Russian No 2, Mar-Apr 84 (manuscript received 24 Jul 82) pp 79-83

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scientific specialist, and SKOROKHVATOV, N. A., candidate of physical and  
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Mapping and Cartographic Engineers

[Abstract] Measurements of ocean surface temperature (OST) in a subsatellite  
zone are usually made with an IR radiometer situated at a height of several  
tens of meters from the sea surface. When the radiometer operates in the  
atmospheric transparency window, the influence of absorption in the inter-  
mediate air layer is negligible and the error in measuring OST can be less  
than 0.1 K. In making measurements with such an accuracy it is necessary  
to take into account a number of factors introducing an additional error  
into OST determinations. The most important of these factors are: state  
of the atmosphere, spatial-temporal variations of relative emissivity  
of ocean and influence of reflected long-wave solar radiation. Since  
the contribution of these factors to the error in measuring OST usually  
does not exceed several tenths of 1 K, actual determinations require  
long-term continuous registry of OST under different hydrometeorological  
conditions with high-response instrumentation. Such work was carried  
out on the 42nd voyage of the "Mikhail Lomonosov." The instrumental  
error in measuring temperature under laboratory conditions is 0.05 K,  
spectral interval 10-11  $\mu\text{m}$ , angular field of view 0.01 sr, time constant  
1 sec, dynamic range in measuring OST 0-40°C. The authors give a theoret-  
ical evaluation of the influence of these factors on errors in measuring  
OST. In order to decrease the influence of these factors (primarily  
solar radiation) the radiometer must be oriented in a definite way.  
Specific formulas are derived for direct computation of the errors intro-  
duced by these factors. Figures 2; references: 2 Russian.  
[236-5303]

UDC 528.2/.3:550.83(26)

USE OF THREE 'OMEGA' RADIONAVIGATION SYSTEM POSITION LINES FOR SOLVING  
PROBLEMS IN MARINE GEODESY

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEODEZIYA I AEROFOTOS"YEMKA  
in Russian No 2, Mar-Apr 84 (manuscript received 10 Feb 83) pp 26-30

MONAKHOV, V. A., assistant, and IORDANSKIY, I. A., engineer, Moscow Order  
of Lenin Institute of Geodetic, Aerial Mapping and Cartographic Engineers

[Abstract] The intersection of two position lines determined using a radio-geodetic or radionavigation system is used in determining a ship's position. The article describes a method for using three position lines for this purpose which gives a considerable increase in the accuracy of position determinations. A program is formulated for this purpose and for evaluating the results. The program, for use with the "Omega" radionavigation system, requires use of an "Elektronika D3-28" minicomputer. Computers of this type are carried on virtually all vessels performing geodetic work at sea. The program, although developed for the "Omega," can be used for other radiogeodetic and radionavigation systems capable of forming three position lines. The basis for the presented method is the iteration method with the use of approximate ship's coordinates. The results of implementation of the program (ship's coordinates and mean square position error) are fed out to a computer display. In the computations the mean square error in determining the ship's coordinates from three position lines for the "Omega" is 0.9 km (with use of two position lines--1.6 km); the accuracy in computing the ship's coordinates does not exceed 2", corresponding to an accuracy in determining the ship's position of less than 75 m. Computations under the program require 10 seconds. The program for determining the ship's coordinates also makes it possible to use two position lines by introducing the parameters of one of them into the program twice. Figures 1; references: 3 Russian.  
[236-5303]

UDC 911.2:551.46.09.628.5(268)

DRIFTING ICE AS MECHANICAL FACTOR IN PURIFYING AND POLLUTING HYDROSPHERE

Leningrad IZVESTIYA VSESOYUZNOGO GEOGRAFICHESKOGO OBSHCHESTVA in Russian  
Vol 116, No 3, May-Jun 84) (manuscript received 16 Dec 83) pp 231-237

IZMAYLOV, V. V.

[Abstract] An ice cover is capable of accumulating (sorbing) petroleum products present at a water surface, absorbing these products up to  $\frac{1}{4}$  of its weight. Ice, as one of the most mobile forms of relief on the earth's surface, is capable of transporting chemical substances of anthropogenic

origin for great distances from pollution sources. The accumulation of petroleum products by the ice is the result primarily of three processes: capture of petroleum products from water during ice formation, ice sorption and migration of petroleum products from the lower to the upper ice surface through capillaries and voids forming during the hummocking of ice. Observations were made on the "SP-22" drifting station to ascertain the migration of petroleum products artificially introduced into young, one-year and perennial ice and icebergs. It was found, for example, that in ice of different structure and texture during the spring-summer season the rate of migration of petroleum hydrocarbons in an upward direction varied from 2 to 49 cm/day. The temperature gradient in the atmosphere - petroleum product - ice (snow) - sea water system plays the dominant role in movement of a petroleum product toward the ice surface. The petroleum products sooner or later appear on the surface of the ice cover as a result of operation of the vertical migration mechanism. At the surface the petroleum hydrocarbons are transformed under the influence of evaporation, photooxidation and biological utilization. Allowance for the ice factor is essential in computing the transport of petroleum products from one basin to another, for detection of zones of purification and pollution in the seas and oceans, for determining the strength characteristics of polluted ice, in predicting the times of freezing and melting of ice and in studying the anomalousness of heat-, moisture-, gas- and energy exchange between the hydrosphere and atmosphere at regional and planetary scales. The experimental studies and hypothetical computations presented or reviewed in this article made it possible to draw quantitative conclusions concerning the role of drifting ice as an important factor in the transport of petroleum pollutants from one basin to another. A knowledge of ice drift in the regions of its melting makes it possible to determine regions of probable purification of waters from petroleum products by ice and to indicate the places of dumping of pollutants at the centers of melting of the ice cover. Figures 1; references 6: 5 Russian, 1 Western.  
[229-5303]

UDC 911.2:551.461:556.5

# WORLD OCEAN LEVEL OSCILLATIONS AND THEIR RELATIONSHIP TO CHANGE IN INFLOW OF CONTINENTAL WATERS

Leningrad IZVESTIYA VSESOYUZNOGO GEOGRAFICHESKOGO OBSHCHESTVA in Russian  
Vol 116, No 3, May-Jun 84 (manuscript received 25 May 82) pp 224-231

VOSKRESENSKIY, K. P., BABKIN, V. I., GRIGORKINA, T. Ye. and BARKHATOVA, V. Yu.

[Abstract] Due to the lack of information on the annual values of water balance elements in the world ocean, a study of its level variations is possible only in relation to the inflow of continental waters. This concept



was initially studied in an earlier article (K. P. Voskresenskiy, et al., IZV. VGO, Vol 112, No 6, pp 537-541, 1980). In that study the authors presented a statistical generalization of world ocean fluctuations as a function of variations in the total inflow of continental waters and solar activity indices. The model used was based on discrete Markov chains constructed for three states: inflow of continental waters, ocean levels and Wolf numbers. Three classes were defined for each of these characteristics: for ocean levels--low, medium, high; for inflow of continental waters--low, medium high; for solar activity--low, medium high. Matrices of the probabilities of transition of ocean levels, inflow of continental waters and Wolf numbers from one class to others are given in Tables 1, 2, 3. These matrices reveal some regularities in variations in ocean levels during the observation period 1918-1964. For example, after a year with a relatively low Pacific Ocean level, it is most probable that there will be a year with a medium level or again a year with a low level. The Atlantic Ocean is characterized by a predominance of a low level; the appearance of medium and high levels after low levels is improbable. Level transitions from class to class for the Indian Ocean are similar to those for the Atlantic Ocean. In the Arctic Ocean there is a small probability of transition of relatively low levels to other classes. In the world ocean as a whole there is a low probability of transition of relatively low levels into medium and high levels. For the world ocean after years with a low level with a high probability this in turn will be followed by years with a low level and years with a high level will be followed by years with a high level. The statistical analysis suggests an influence of years of high and low solar activity on the processes responsible for ocean level. A similar analysis is presented for the influence of the inflow of continental waters on ocean level. Figures 2, tables 5; references: 2 Russian.  
[229-5303]

UDC 551.54+551.5

#### CONTRIBUTION TO THEORY OF OCEAN-ATMOSPHERE GAS EXCHANGE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 275, No 5, Apr 84  
(manuscript received 17 Aug 83) pp 1185-1189

SAVENKO, V. S. and LEBEDEV, V. L., Moscow State University imeni  
M. V. Lomonosov

[Abstract] There is still no adequately simple method for quantitative computations of the intensity of ocean-atmosphere gas exchange. In an earlier article (DAN, Vol 266, No 5, 1982) the author demonstrated that the combining of the theory of a renewing surface and concepts concerning microconvection caused by the formation of a locally periodically destructible surface film affords a possibility for developing a simple quantitative method for



computing gas exchange under natural conditions. An expression was derived for the intensity of a gas flow applicable to a gas exchange model when there is molecular-diffusional absorption (release) of gas from one half-space (air) to the other (water) during a time  $\tau$  equal to the mean period of presence of water particles at the surface to the time of their sinking with maintenance of a constant gas concentration at the interface. The work of other authors along these lines is reviewed. Emphasis is on behavior of the cold film (convection time scale). At wind speeds up to 4-5 m/sec it is determined almost exclusively by the cooling of the surface water layer (free convection); this cooling is due to loss of heat in evaporation, effective radiation and contact heat exchange with the air. However, at wind speeds greater than 4-5 m/sec the free convection regime is replaced by forced convection. A series of equations is derived for computing the effective lifetime of the cold film, the principal parameter of the convective-diffusional theory of gas exchange. A comparison of the theoretical principles reviewed or formulated in the article revealed good agreement. It is shown that there is a jumplike change in exchange processes with transition from free to forced convection. Figures 1, tables 1; references 14:

11 Russian, 3 Western.

[244-5303]

UDC 551.46(378.4)

#### DEVELOPING A CURRICULUM ON METHODS OF FIELD GEOGRAPHIC STUDIES FOR OCEANOGRAPHY SPECIALISTS

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 5: GEOGRAFIYA in Russian No 5, Sep-Oct 84 (manuscript received 11 Jan 84) pp 36-40

DOBROVOL'SKIY, A. D.

[Abstract] The new teaching plan of the Department of Geography at Moscow University now includes a special course which serves as an introduction to the specialty, showing major trends in geography and methods of geographic studies. The course is intended to reveal the philosophy of the geographic aspect of the study of nature, familiarize students with specific types of research, observations, collection and processing of materials. The purpose of the course is to prepare the students for practice in the specialty, which begins after the second year of study. Navigation of oceanographic research vessels and general oceanography, covering the physical properties of sea water, are also included in the introductory courses, as is practical oceanography and safety techniques. The major distinguishing feature of the cycle of courses is their geographic orientation. The first year of study, as well as the first year of practice after study, is basically related to geography,

the interrelationship and interactions of processes occurring in the earth's geographic milieu. Beginning in the second year of study the ideas are developed in their distinctly oceanographic aspect.  
[65-6508]

UDC 551.46.09:628.5

#### TWO-DIMENSIONAL FLOW MODEL OF IRREGULAR OIL SLICK ON OCEAN SURFACE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 278, No 1, Sep 84  
(manuscript received 10 May 83) pp 215-219

ANIKIYEV, V. V., IL'ICHEV, V. I., academician and MISHUKOV, V. F.,  
Pacific Oceanology Institute, Far Eastern Scientific Center,  
USSR Academy of Sciences, Vladivostok

[Abstract] Several models of oil slicks have been studied, showing the need for further study to determine natural processes of transforming crude oil under oceanic conditions. Some typical features are large differences in thickness with most oil concentrated in a central nucleus, gradual decrease in this irregularity, dependence on physicochemical properties and oil volume to determine flow, and eventual disintegration into belts of oil. This article gives calculations assessing the forces involved in changes in shape and flow patterns during axisymmetric movement. Forces encouraging flow and those inhibiting it are discussed. The calculations are intended to explain the development of irregularities in the oil slick as it spreads, determine its maximum surface area, and predict surface changes during its duration based on physicochemical properties and total volume of the oil spill. Figures 3; references 13: 8 Russian, 5 Western.

[81-12131]

UDC 911.2:551.334(4)

#### DYNAMICS OF PLEISTOCENE GLACIATION AND NATURE OF TRANSGRESSIONS OF MARINE BASINS IN NORTHERN EUROPE

Leningrad IZVESTIYA VSESOYUZNOGO GEOGRAFICHESKOGO OBSHCHESTVA in Russian Vol 116, No 4, Jul-Aug 84 (manuscript received 12 Mar 83) pp 323-328

KOSHECHKIN, B. I.

[Abstract] Extensive new factual material allows significant expansion of our concepts concerning the position of the ice divide of the Scandinavian shield and its migrations during the evolution of glaciation. Throughout

the entire Pleistocene in Fenoscandia there was a system of two major ice divides: the northern with a western center of glaciation) and southern (with an eastern center of glaciation). With relatively thin glaciation there was a northern zone and western center of glaciation, while with thicker glaciation the southern zone and eastern center of glaciation were predominant. The position of the center glaciation in the west or east of Fenoscandia determined the corresponding western or eastern asymmetry of the glacioisostatic depression of the crust and plan of ascending movements directed toward compensation of the depression. The western or eastern position of the center of isostatic depression determined the corresponding position of the area of transgression of ocean waters resulting from subsidence of the crust. This model is general in nature and must be refined as more details become known concerning the dynamics of glaciation in the Pleistocene. References 23: 14 Russian, 9 Western.  
[45-6508)

UDC 551.462(262.5)

# SOME RESULTS OF STUDY OF PHYSICOMECHANICAL PROPERTIES OF ABYSSAL BLACK SEA BOTTOM DEPOSITS USING NUCLEAR GEOPHYSICAL METHODS

Kiev GEOLOGICHESKIY ZHURNAL in Russian Vol 44, No 5, Sep-Oct 84  
(manuscript received 17 Oct 83) pp 76-84

ZVOL'SKIY, S. T., MEL'NIK, V. I. and VOVK, P. K., Geological Sciences  
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[Abstract] Experimental data on the physicommechanical properties of abyssal Black Sea bottom sediments during expeditions of the "Akademik Vernadskiy," "Mikhail Lomonosov," "Faddey Bellingsgauzen" and "Gidrolog" during the years 1972-1982 are presented. Extensive use was made of nuclear geophysical methods and radioisotope apparatus which included a gamma densimeter and a neutron instrument for measuring the moisture content of bottom sediments. The patterns of distribution of the most important indices of physicommechanical properties in the upper layer of abyssal (200-2,200 m) bottom sediments in the sea were characterized by a sublatitudinal section of these sediments taking in the continental slope, its foot and the abyssal plain; isolines of the mean volumetric mass of the upper 80-cm stratum of undissected recent and ancient sediments and a test area covering two parallel Danube submarine canyons; a transverse section of the investigated layer of sediments in these canyons; graphs of the distribution of the indices of physicommechanical properties in the studied layer of bottom sediments at a total of 174 stations (8,602 determinations of volumetric mass, volumetric moisture content, mass moisture content in sediments). The investigated sediments were of a fluid, viscofluid or slightly plastic character of Holocene and Würmian age in different stages of formation of their physicommechanical properties. All of these situations are discussed in detail.

Figure 1 shows the distribution of volumetric mass and volumetric moisture content in the upper layer of bottom sediments: Fig 2 is an isoline map of the volumetric mass of the upper 80-cm layer. It was found that in the formation of the physicomachanical properties of abyssal bottom sediments an important role is played by stable cyclonic sea currents. There is a clearly expressed increase in volumetric mass and a decrease in moisture content of bottom sediments with depth. Figures 4; references 20: 19 Russian, 1 Western.  
[94-5303]

UDC 550.384

# USE OF PALEOMAGNETIC DATA IN TECTONIC ANALYSIS OF OCEANIC STRUCTURES

Kiev GEOLOGICHESKIY ZHURNAL in Russian Vol 44, No 5, Sep-Oct 84  
(manuscript received 1 Apr 83) pp 85-87

GEVORK'YAN, V. Kh., MARKOVSKIY, V. S. and LOMAKIN, I. E., Geological Sciences Institute, Ukrainian Academy of Sciences, Kiev; Geophysical Institute imeni S. I. Subbotin, Ukrainian Academy of Sciences, Kiev

[Abstract] An oriented piece of massive fine-grained aphyric basalt was recovered during an underwater geological survey from aboard the "Sever-2-bis" submersible on the slope of the Arabian Sea-Indian Ocean Ridge from an underwater show at a depth of 1,550 m. The results of petrochemical studies made it possible to assign this sample to the group of oceanic tholeiites. A study was made of remanent magnetization, magnetic susceptibility, the parameter  $Q_n = I_n/\chi T$  ( $T$  is magnetic field strength), declination and inclination of four fragments. The natural magnetic parameters are typical for ocean floor tholeiites and the high densities (2.8-2.86 g/cm<sup>3</sup>) are characteristic for unmodified basalts. Laboratory work was carried out for thermal demagnetization of the remanent magnetization and determination of its resistance to destruction by a variable magnetic field in order to evaluate the reliability of use of paleomagnetic information for tectonic constructions. This work indicated that the vector of remanent magnetization, whose mean direction is characterized by a declination of 297° and an inclination of +57°, represents the direction of the geomagnetic field during the cooling of basaltic magma. It is shown that paleomagnetic data, together with the results of a geological and geomorphological survey, make it possible to determine the principal features of this sector of the Arabian Sea-Indian Ocean Ridge. The vector of remanent magnetization of rocks should be studied for interpretation of the tectonic nature of lithospheric blocks. This is particularly important in studying the ocean floor for which so few observational data are available. Figures 2, tables 2; references 12: 6 Russian, 6 Western.  
[94-5303]



UDC 552.54:553.061.13(470)

KVAISINSKIY BARRIER REEF AND ITS ROLE IN ORE LOCALIZATION (GEORGIA)

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA GEOLOGICHESKAYA in Russian  
No 8, Aug 84 (manuscript received 5 Mar 83) pp 88-100

ZHABIN, A. G., SAMSONOVA, N. S. and TODRIA, V. A., Mineralogy, Geochemistry and Crystal Chemistry of Rare Elements Institute, Moscow; Geology Institute, Georgian Academy of Sciences, Tbilisi

[Abstract] The structure of the Kvaisin lead-zinc deposit is quite simple and unique. It is a vertical wall-shaped sublatitudinal wedge of organogenic limestones within a sedimentary-volcanogenic basaltoid mass. The wedge is 150-300 m thick, at least 1200 m high and extends for over 1500 m in width. The internal structure of the limestone wedge is described. Faunistic dating of the limestones in the wedge indicate its origin to have been as a barrier reef located at a cosedimentation fault. Reef masses buried within sedimentary masses function as monolithic unstratified rigid-elastic bodies. This is the reason that fractures, crumpling and brecciation are associated with them as a result of the mechanical interaction of the reef body with the surrounding rock as it undergoes fold formation, block or other movement. These contact zones are joined into an overall system of regional ore conducting fractures. As a rigid-elastic body, the reef mass has a specific internal structure, a connecting system of cavities, facilitating circulation and accumulation of ore-bearing hydrosystems. Reef masses consisting of limestones and associated evaporite formations are geochemical solid-phase barriers causing sharp changes in the composition of solutions reacting with them and precipitation of ore sediments as insoluble compounds, such as sulfides or oxides. Figures 7; references 29: 28 Russian, 1 Western.  
[41-6508]

UDC 551.465

CALCULATION OF LEVEL SURFACE IN PROBLEMS OF LARGE-SCALE OCEAN CIRCULATION

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 277, No 4, Aug 84  
(manuscript received 3 Feb 84) pp 961-964

BERESTOV, A. L. and YEFREMOV, S. A., Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences, Moscow

[Abstract] The purpose of this work is to demonstrate the possibility of a direct method of calculating the sea level surface in models of large-scale ocean circulation. It is obvious that in order for a finite difference system to be adequate to a physical process, the integral laws of conservation



must be fulfilled, conserving masses with no sources or sinks, and conserving energy and momentum with no dissipative or external forces. Equations are derived to model the general circulation of the atmosphere. The difficulty of applying these equations to describe the large-scale circulation of the ocean results from the fact that in modeling ocean dynamics two problems arise which do not exist in computation of the general circulation of the atmosphere. These include the need to consider bottom relief and the problem of assigning boundary conditions in multiply connected areas. The method here suggested allows calculation of the sea level of the surface of the ocean directly using the initial equations of hydrodynamics. This approach allows significantly simpler and more accurate solution of the problem of hydrodynamics of the ocean and construction of a model considering satellite observation data. Figures 2, references 7: 4 Russian, 3 Western.  
[30-6508]

UDC 551.465.11

#### DOUBLE AND INVERSE TAYLOR-HOGG VORTICES IN A STRATIFIED OCEAN

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 277, No 4, Aug 84  
(manuscript received 3 Feb 84) pp 967-971

ZYRYANOV, V. N., Water Problems Institute, USSR Academy of Sciences, Moscow

[Abstract] The formation of a column of rotating fluids over a dome-shaped bottom relief feature when a current occurs in a homogeneous fluid is analyzed. It is shown that consideration of the  $\beta$  effect leads to new phenomena in a stratified ocean: formation above the underwater feature of double and inverse Taylor-Hogg vortices and closing of the Taylor-Hogg satellite vortex near the bottom. When a baroclinic mode of flow vortexing arises above an underwater mountain in a constant current, it changes its direction in the surface layers because the cyclonic satellite vortex arising downstream from the mountain in the bottom layers closes the deep Taylor-Hogg cone with its upper portion. In the surface layers downstream from the mountain a new anticone vortex satellite arises with its points directed downward. With a current flow past a crater a double vortex cyclone-anticyclone cone arises near the bottom, above which in the surface layers an inverted conical vortex is formed. These are called double and inverted vortex Taylor-Hogg cones. Figures 2, references 8: 3 Russian, 5 Western.  
[30-6508]

UDC 551.464.34:[528.9:001.51](265)

MATHEMATICAL-CARTOGRAPHIC MODEL FOR STUDY OF DISTRIBUTION OF HYDROCHEMICAL ELEMENTS IN SEA WATER (USING DISSOLVED OXYGEN IN THE PACIFIC OCEAN AS AN EXAMPLE)

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 5: GEOGRAFIYA in Russian No 4, Jul-Aug 84 (manuscript received 10 Apr 83) pp 51-55

ZOLOTOV, A. A. and SERVENYUK, S. N.

[Abstract] There has been interest lately in studies of the structure of distribution of hydrochemical elements in ocean waters by various modeling methods. The essence of modeling of this type is discussed using the example of studying the structure of distribution of oxygen in the Pacific Ocean. Initial information is a series of 7 maps of dissolved oxygen at various depths from the surface to 2000 meters. The problem was, using fixed values of the index at the discrete monitor points and continuous functions and maps to describe the structure of the spatial distribution with the necessary accuracy. This was done using a method of three-dimensional polynomial regression for which the independent variables are the spatial coordinates; the dependent variable is the quantitative characteristic being studied. The criterion used to evaluate the quality of analytic description is defined in advance. Equations are obtained to describe the distribution of dissolved oxygen at the depth studied. The model is quite suitable for automation, including: digitizing of initial maps or their individual elements; processing of digital information using known algorithms; automatic construction of derivative maps of individual spatial characteristics, such as profiles, or determination of quantitative cartometric data. Figures 4, references: 3 Russian.  
[8-6508]

UDC 552.5:551.35

RADIOCARBON AND ANTHROPOGENIC FACTOR IN BOTTOM DEPOSITS OF DEEP-WATER DEPRESSIONS IN WESTERN BALTIC

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 277, No 5, Aug 84 (manuscript received 22 Feb 84) pp 1213-1215

KUPTSOV, V. M., LISITSYN, A. P., corresponding member, USSR Academy of Sciences Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences, Moscow

[Abstract] A characteristic feature of the Baltic Sea over the past 800 to 1200 years has been increased arrival of sedimentary material resulting from

the anthropogenic factor - clearing of forests and plowing of fields in the watershed. This factor has been particularly strongly felt in the western Baltic, receiving material carried by rivers from central Europe. Plowing of fields causes an increase in the quantity of organic matter, which greatly distorts the age values determined by the radiocarbon method in sediment. In the summer of 1978, the 26th cruise of the research vessel "Akademik Kurchatov" collected core samples from bottom sediments in the Ankona depression, determining the age of two of them by radiocarbon dating. Variation in radiocarbon dates with depth of the cores are noted. It is concluded that the great increase in rates of sedimentation in the western Baltic over the past 1000 to 1200 years has been caused by an increase in the arrival of sedimentary material washed down from the watershed. This is related to anthropogenic factors--clearing of forests and plowing of fields. Figures 2; references 5: 3 Russian, 2 Western.  
[46-6508]

UDC 539.12+551.48:535.3

#### LUMINESCENCE OF DEEP WATER IN LAKE BAIKAL

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 277, No 5, Aug 84  
(manuscript received 6 Jan 84) pp 1240-1244

BEZRUKOV, L. B., BUDNEV, N. M., GAL'PERIN, M. D., DOBRYNIN, V. I., DUDKIN, G. N., ZURBANOV, V. L., KOKHOMSKIY, A. G., NIKIFOROV, S. A., POLESHCHUK, V. A., SHERSTYANKIN, P. P. and SHESTAKOV, A. A., Nuclear Research Institute, USSR Academy of Sciences, Moscow; Applied Physics Scientific Research Institute, Irkutsk State University; Nuclear Physics Scientific Research Institute, Tomsk Polytechnical Institute; Limnology Institute, Siberian Department, USSR Academy of Sciences, Listvyanka, Irkutsk Oblast

[Abstract] Studies were performed in Lake Baikal in 1982 and 1983 as part of a series of experiments on deep-water detection of muons and neutrinos. The experiments involved studies of the light field of the lake to determine the background conditions for recording of Cherenkov radiation emitted in the water by relativistic charged particles. One result was the discovery of lake water luminescence. Another experiment was performed in 1982 intended to search for bioluminescence initiated by mechanical excitation of the water. The studies of the light field of Lake Baikal were continued in 1983. Luminescence was observed at all depths studied, 150 to 1350 m. Luminescence changes with depth, decreasing toward the greatest depths. It was not found to vary as a function of mechanical excitation of the medium. The intensity of luminescence cannot be explained by decay of radioactive isotopes. Figures 3; references 5: 4 Russian, 1 Western.  
[46-6508]

UDC 550.312

# GRAVITATIONAL ANOMALIES AND DENSITY MODELS OF INDIAN OCEAN LITHOSPHERE

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 4: GEOLOGIYA in Russian  
No 4, Jul-Aug 84 (manuscript received 2 Mar 84) pp 74-81

CAYNANOV, A. G., BULYCHEV, A. A., GILOD, D. A., LEYBOV, M. B.,  
MELIKHOV, V. R. and POLYAKOVA, L. P.

[Abstract] Using gravimetric data in  $1^\circ \times 1^\circ$  trapezoids obtained by the Department of Geophysical Methods of Research on the Earth's Crust, Department of Geology, Moscow State University, gravimetric maps were constructed of the Indian Ocean at various scales and reductions. The force of gravity was mapped for the system of international reference points, all anomalies related to the 1930 normal international formula. The Indian Ocean is subdivided into several areas on the basis of these maps: areas of deep ocean trenches with bottom depths of 4000 to 6000 m, with relatively quiet gravitational force field and near-zero negative or positive Faye anomalies; areas of underwater ridges, mountains, elevations and islands, including rift zones, areas with elevated Faye anomalies; and transition zones from the continents to the Indian Ocean, further divided into two subzones: passive transition zones and active transition zones. A diagram of lithosphere thicknesses and density models of the crust and lithosphere are constructed along profiles intersecting the various morphostructures of the Indian Ocean. Figures 3; references 27: 23 Russian, 4 Western.  
[350-6508]

UDC 551.465.11:551.511.3

# INTEGRAL CHARACTERISTICS OF LOCALIZED VORTICES ON $\beta$ PLANE

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 20, No 8 Aug 84 (manuscript received 2 Mar 83; after revision 14 Jul 83)  
pp 733-740

LARICHEV, V. D., Oceanology Institute, USSR Academy of Sciences

[Abstract] This article discusses the physical sense of integral invariants in the potential vorticity equation in a simple model of a barotropic ocean on the  $\beta$  plane and the application of these invariants to two-dimensional unified Rossby waves. Their integration is hindered by the specifics of quasigeostrophic movement. The noninertial nature of the system of reference tied to the rotating earth also decreases the number of fundamental physical quantities conserved. Individualized waves transfer mass, energy, enstrophy but not vorticity or momentum. A criterion is suggested for identification of individualized waves in observational data. References 10: 3 Russian, 7 Western.  
[55-6508]



UDC 551.465.153

HORIZONTAL COHERENCE OF TEMPERATURE MICROSTRUCTURE IN UPPER OCEAN LAYER

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 20, No 8 Aug 84 (manuscript received 4 Mar 83; after revision 23 Dec 83)  
pp 741-748

BEREZHNAYA, N. D., LYUBITSKIY, A. A. and ROZENBERG, A. D., Radio Physics  
Institute, Ukrainian Academy of Sciences; Oceanology Institute, USSR  
Academy of Sciences

[Abstract] Results are presented from field studies of horizontal coherence of temperature microstructure in a small sea. The purpose of the work was to produce quantitative characteristics of the spatial variability of microstructural elements in variously stratified layers of the sea. Measurements were performed in the summer of 1977 in the Caspian Sea from a nonmoving station on a piling. The depth of the sea at the point was 40 m. The temperature structure was studied by soundings through the depth of the water by two horizontally separated sensors. Six measurement cycles were performed between 26 July and 11 August 1977, each consisting of 5 to 6 soundings performed at intervals of 7 minutes. The horizontal spacing between sensors varied between 5 and 100 cm. The microstructure of the temperature field apparently results from rather intensive small-scale turbulence generated by surface waves and differences in current velocities. One characteristic feature of the behavior of the coherence functions in the area of the thermocline is an increase in the level of  $G^2$  in the shortwave end of the spectrum, while  $\delta_{0.5}(k_z)/\lambda_z$  is significantly greater than one in this range. The spectral density of temperature fluctuations in the thermocline is several orders of magnitude greater than the level of hardware noise, indicating that the observed effect is genuine. The relatively ordered microscopic jump in temperature extending horizontally or a small-scale internal wave propagating at an angle to the horizontal leads to an increase in coherence. Figures 5; references 7: 5 Russian, 2 Western. [55-6508]



UDC 551.465.1

# GENERATION OF SYNOPTIC OCEAN EDDIES IN "POLYGON-70" REGION

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 20, No 8 Aug 84 (manuscript received 17 Jun 83) pp 749-753

KOSHLIYAKOV, M. N. and YAREMCHUK, M. I., Oceanology Institute, USSR Academy of Sciences

[Abstract] Synoptic disturbances were observed in the "Polygon-70" experiment as a result of baroclinic instability in the large-scale northern trades current. This article studies this effect in more detail by spectral analysis of data on measurement of currents in "polygon-70." All time series of zonal and meridional components of the current velocities at the 200, 300, 400, 500, 600, 1000 and 1500 m levels were preliminarily smoothed with an effective period of 3.5 days in order to determine the synoptic component of the current field. Within the framework of the spectral approach it can be considered that synoptic oscillations in currents in the region consisted of oscillations of primarily meridional currents with a period of about 80 days plus low-frequency oscillations primarily in zonal currents, the natural period of which cannot be determined due to the low resolution of the frequency spectra. The 80-day oscillations were found to have high coherence over depth and a vertical phase shift of about 30° between the 200 and 1000 m levels. Some of the potential energy of the current is transformed to potential energy in eddies. Figures 4; references 12: 9 Russian, 3 Western.  
[55-6508]

UDC 551.465.1

# EXPERIMENTAL STUDY OF VISCOUS SPREADING OF SPOT OF MIXED FLUID IN STRATIFIED MEDIUM

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 20, No 8 Aug 84 (manuscript received 6 Jul 83) pp 754-758

ABRAMYAN, T. O., Oceanology Institute, USSR Academy of Sciences

[Abstract] An experimental study is presented of the viscous stage of spreading of a cylindrical spot of a mixed fluid of constant volume in a linearly stratified medium. An organic glass bath was filled with an aqueous NaCl solution at room temperature with density increasing linearly with depth. A porous ceramic cylinder 15 mm in diameter and 48 mm long was used to insert 30 cm<sup>3</sup> of a colored fluid equal in density to the NaCl solution at the point of the cylinder into the bath over a period of about 1 minute. The process of spreading of the spot was photographed perpendicular to the axis of the spot over a period averaging 500 seconds. Spots remained practically symmetrical, spreading at the isopycnic level. The results of all experiments can be approximated by the exponential function  $L e^{-t/\alpha}$ , where

$\alpha = 0.17 \pm 0.03$  with a mean correlation function of  $0.997 \pm 0.002$ . The results confirm that the spreading of a cylindrical spot of mixed fluid is a self-similar process. Figures 5; references 10: 8 Russian, 2 Western. [55-6508]

UDC 551.596.9:551.466.2

#### STUDY OF INTRASOUND IN ATMOSPHERE OF TURBULENT HETEROGENEITY NEAR OCEAN SURFACE

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 20, No 8 Aug 84 (manuscript received 19 Apr 83) pp 759-766

PAVLOV, V. I. and SUKHORUKOV, A. I., Moscow State University

[Abstract] A study is made of the effect of radiation of infrasound into the atmosphere of a vortical heterogeneity located near the ocean surface. The energy characteristics of the radiation are estimated. A hydrodynamic equation in tensor form is used to describe the process. The radiation of infrasound into the atmosphere for the local area of active vortexing is found to make a significant contribution to the level of low-frequency noise over the ocean surface. A significant effect is observed at great distances from the source area. Figures 1; references 9: 8 Russian, 1 Western. [55-6508]

UDC 551.511.3

#### LABORATORY MODEL OF CONVECTION IN ROTATING CIRCULAR CHANNELS WITH HORIZONTALLY AND VERTICALLY NONUNIFORM HEATING

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 20, No 8 Aug 84 (manuscript received 8 Apr 83) pp 767-770

BUBNOV, B. M., Atmospheric Physics Institute, USSR Academy of Sciences

[Abstract] A model study is presented of shear flow in a rotating convective system in order to study the simultaneous effect of baroclinic and shear instabilities. The experiments were performed in heated rotating circular vessels, forming various eddies and axisymmetric movements. Pictures of the convective flow at great temperature differences are presented. The experimental apparatus allows a study of three basically different mechanisms of instability of fluid motion: with little vertical flow of heat, movement is formed entirely by the horizontal temperature nonuniformities; with a high relative effect of vertically nonuniform heating a system of small eddies is formed corresponding to turbulent convection in the rotating system. The additional enveloping flow results from limitations of movement by the heated

horizontal surface and the presence of heating at the walls; when the effect of vertically and horizontally nonuniform heating is balanced, shear flow occurs. Figures 4; references 6: 5 Russian, 1 Western.  
[55-6508]

UDC 551.463.5:535.34

#### FINE STRUCTURE OF VERTICAL DISTRIBUTION OF LIGHT ATTENUATION INDEX OF SEA WATER

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 20, No 8 Aug 84 (manuscript received 23 Mar 83) pp 773-776

BURENKOV, V. I., VASIL'KOV, A. P. and STEFANTSEV, L. A., Oceanology Institute, USSR Academy of Sciences

[Abstract] A study is made of some of the results of investigation of the fine structure of the attenuation index  $\epsilon$  performed at various times at the Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences. Measurements were made by means of a submerged transparency meter with built-in temperature and pressure sensors, allowing simultaneous recording of changes in attenuation and temperature with depth. Two types of heterogeneities are observed in the fine structure of vertical  $\epsilon$  distributions: narrow local layers of reduced transparency, not over 2-3 m thick with transparency change usually not over  $0.1-0.02 \text{ m}^{-1}$ ; and quasistep structures, alternation of layers with high and low  $\epsilon$  gradients, sometimes up to tens of meters thick and persisting over longer times. Sample vertical distributions are diagrammed. It is concluded that quasistep structures are rather common in the vertical profiles of the attenuation index. The depth of layers with a higher gradient of the attenuation index and temperature usually coincides. This indicates that fine structure heterogeneities in  $\epsilon$  profiles result from precesses responsible for the existence of quasistep structures in the temperature profile as well. Figures 2; references: 5 Russian.  
[55-6508]

UDC 551.465.5

#### DYNAMICS OF SYNOPTIC OPEN OCEAN EDDIES BASED ON "POLYGON-67" DATA

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 20, No 8 Aug 84 (manuscript received 24 Oct 83; after revision 17 Feb 84) pp 776-780

SAZHINA, T. G., Institute of Oceanology, USSR Academy of Sciences

[Abstract] Two bathometric surveys of a rectangle limited by meridian  $63^{\circ}00'$  and  $66^{\circ}30'$  E and parallels  $10^{\circ}00'$  and  $15^{\circ}00'$  N were reprocessed.

Stations were placed in a square grid with a spacing of 30 angular minutes. The first survey was made 21 January through 7 February 1967, the second from 20 March through 6 April 1967. The fields of densities and current functions can be approximately interpreted as averages over the entire period. Observations extended from the surface to a depth of 1500 m. The mean distribution inherent for the region was subtracted from the density field. To remove nongeostrophic disturbances related to internal gravity waves, two-dimensional smoothing of the field of densities with a cosine filter was performed. A dynamic method was then used to determine the field of geostrophic disturbances in the current function relative to the zero surface at 1500 m. Joint maps of geostrophic disturbances of the density field and current function were then constructed for various levels. The maps show that the synoptic variability in this region is quite great. During the first survey two cyclonic eddies were observed with diameters of 250 to 300 km, during the second survey - a cyclone and an anticyclone were apparent. Figures 4; references 11: 10 Russian, 1 Western. [55-6508]

UDC 551.465(263)

#### DYNAMICS OF SYNOPTIC OPEN OCEAN EDDIES IN POLYMODE AREA .

Moscow OKEANOLOGIYA in Russian Vol 24, No 4, Jul-Aug 84  
(manuscript received 13 Oct 83) pp 549-557

GRACHEV, Yu. M., KOSHLyakOV, M. N., NECHAYEV, D. A., SAZHINA, T. G. and YAREMCHUK, M. I., Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences, Moscow

[Abstract] Continuing their analysis of the dynamics of synoptic open ocean eddies based on data from the POLYMODE experiment of July 1977-August 1978 in the Sargasso Sea, the authors studied the energy status of synoptic eddies. Primary processing of measured data on currents included smoothing of current velocity series with a period of 8 days to filter out inertial, tidal and medium-scale oscillations, plus interpolation of the velocity field in time, depth and horizontally. In creating a model of the large-scale current it was assumed that at any level and any moment in time the current in this area is a plane-parallel flow with a constant direction of 240 or 60° and a constant linear velocity in the transverse direction. The results of the calculations were used to analyze balances of available potential and kinetic energy in synoptic currents in the POLYMODE area. The total synoptic current energy for the entire depth of the ocean was  $3.8 \text{ J/cm}^2$ , approximately equally divided between potential energy and kinetic energy. Figures 10; references 16: 11 Russian, 5 Western. [32-6508]



UDC 551.463

EVOLUTION OF SET OF ROSSBY WAVES TOWARD ANISOTROPIC EQUILIBRIUM STATE

Moscow OKEANOLOGIYA in Russian Vol 24, No 4, Jul-Aug 84  
(manuscript received 28 Oct 83; after revision 1 Dec 83) pp 558-565

REZNIK, G. M., SOOMERE, T. E., Oceanology Institute imeni P. P. Shirshov,  
USSR Academy of Sciences, Moscow

[Abstract] A further description is presented of results of numerical studies of a kinetic equation for weakly linear Rossby waves. The results of numerical calculations indicate with some certainty that when there are no energy sources or sinks the spectrum approaches an equilibrium spectrum described by an equation presented in this article, the sum of the spectrum of zonal flow and equilibrium spectrum of two-dimensional turbulence, regardless of the initial form of the spectrum. The relative fraction of energy of the zonal flow depends on the initial conditions; dissipation increases energy transfer to the zonal flow. Figures 12; references: 6 Russian.  
[32-6508]

UDC 551.465

STABILITY OF ROSSBY WAVES WITHIN FRAMEWORK OF THREE-COMPONENT ANALYSIS

Moscow OKEANOLOGIYA in Russian Vol 24, No 4, Jul-Aug 84  
(manuscript received 29 Aug 83; after revision 27 Dec 83) pp 566-573

MIRABEL', A. P., Oceanology Institute imeni P. P. Shirshov, USSR Academy  
of Sciences, Moscow

[Abstract] When the behavior of small but finite disturbances is studied in the problem of stability of a Rossby wave, the spatial structure of the disturbances can be represented in a form suggested by Gill. This article formulates a criterion for instability of two-dimensional Rossby waves with respect to disturbances consisting of two waves of the same type. The initial nonlinear stage of development of the instability can be studied in a simple model of the process of a three-wave interaction. It is shown that the instability grows most effectively when the wave vectors of the largest disturbance at the point of resonance of the three waves vary by more than  $15^\circ$  from a straight north-south direction. Supercritical states of the three-wave interaction are investigated. Figures 1; references 14:  
6 Russian, 8 Western.  
[32-6508]



UDC 551.465.5

# NATURE OF MAJOR FRONTAL ZONES IN THE OCEAN

Moscow OKEANOLOGIYA in Russian Vol 24, No 4, Jul-Aug 84  
(manuscript received 4 Aug 82; after revision 27 Apr 83) pp 574-577

KOZLOV, V. F. and KUZ'MIN, V. A., Pacific Ocean Oceanology Institute,  
Far Eastern Scientific Center, USSR Academy of Sciences, Vladivostok

[Abstract] It has recently been suggested that compaction during mixing may be significant in the mechanism of maintenance of thermohaline fronts. The authors suggest that compaction upon mixing is the determining factor in the existence of major ocean fronts. Analyzing a hypothetical local mixing curve between subarctic and subtropical water masses, it is shown that successive local compacting can form an area with maximum density between the two masses, causing a drop in sea level and subsequent convergence and formation of a frontal divide. It is thus sufficient for the existence of polar fronts that the indices of subpolar and subtropical water masses not fall on the separatrix. Figures 2; references: 8 Russian.  
[32-6508]

UDC 551.465

# INFLUENCE OF VELOCITY PROFILE CURVATURE ON PARAMETERS OF GROWING WAVES IN SHEAR FLOWS

Moscow OKEANOLOGIYA in Russian Vol 24, No 4, Jul-Aug 84  
(manuscript received 23 Mar 83) pp 578-585

MAKOV, Yu. N. and STEPANYANTS, Yu. A., Applied Physics Institute,  
USSR Academy of Sciences, Gor'kiy

[Abstract] An independent integral equation which follows from the Taylor-Goldstein equation is used to generate a new inequality describing the range of possible values of the complex phase velocity of growing waves in a shear flow. The form of the inequality derived depends significantly on the curvature of the velocity profile, while the maximum possible value of the increment in disturbances with time depends on the buoyancy frequency and wave number. The equations presented in this article yield new estimates of the complex phase velocity of growing wave disturbances. Figure 2; references 10: 6 Russian, 4 Western.  
[32-6508]

UDC 551.465

#### WIND WAVE BISPECTRA

Moscow OKEANOLOGIYA in Russian Vol 24, No 4, Jul-Aug 84  
(manuscript received 5 Jan 83, after revision 26 Oct 83) pp 598-604

YEFIMOV, V. V. and KALMYKOV, V. A., Marine Hydrophysics Institute,  
Ukrainian Academy of Sciences, Sevastopol

[Abstract] Measurements of wave rises were made in the northeastern Black Sea using string wave recorders at 5 points separated by 520 m on a stable base. The sea depth was 30 m; distance from nearest shore about 60 km. The experimentally determined bispectra measured in various stages of development of the wave action are compared with theoretical spectra calculated assuming potential wave motion. Good agreement is found for the first two positive spectral peaks describing the nonlinear three-wave interaction. The relief of the experimental bispectra indicates a broad interval of frequencies within which nonlinear interaction of three spectral components occurs. The sum of the frequencies of the three components is equal to zero. Figures 4; references 16: 4 Russian, 12 Western. [32-6508]

UDC 551.463

#### APPROXIMATE CALCULATION OF PHOTOSYNTHETICALLY ACTIVE RADIATION PENETRATING INTO OCEAN AND ITS SPECTRAL COMPOSITION AT VARIOUS DEPTHS

Moscow OKEANOLOGIYA in Russian Vol 24, No 4, Jul-Aug 84  
(manuscript received 26 May 82; after revision 14 Sep 83) pp 605-610

OCHAKOVSKIY, Yu. Ye., Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences, Moscow

[Abstract] Measurements performed aboard the research vessel "Discoverer" by the author in cooperation with A. Suslyayev allow a judgment to be made concerning the percentage of the total solar radiation flux which penetrates into the ocean. Measurements were made using a pyranometer and X = 603 integrator on the surface of the ocean from noon to sunset. A special variospectrometric underwater light level meter called the VARIPO, specially manufactured for the Oceanology Institute, was used to measure subsurface solar energy. Some 1212 observations were used to calculate the spectral composition of radiation in absolute units of watts per square meter at depths of 5 to 100 m. Figures 3; references 19: 12 Russian, 7 Western. [32-6508]

UDC 551.462:543.27(267.5)

#### CASES IN RED SEA BOTTOM WATERS

Moscow OKEANOLOGIYA in Russian Vol 24, No 4, Jul-Aug 84  
(manuscript received 10 Mar 83) pp 624-627

GEODEKYAN, A. A., AVILOV, V. I., BOL'SHAKOV, A. M. and SVINARENKO, V. K.,  
Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences, Moscow

[Abstract] Gas geochemical studies were performed during the 30th voyage of the research vessel "Akademik Kurchatov" in 1980 to determine the composition and content of dissolved gases in waters near the bottom of the Red Sea in the Atlantis-2 deep water depression with thermal brines and south of the depression along a transverse profile at 18° N. Anomalous gas concentrations were found in the thermal brines in the depression, related to the tectonics of the region. The gas-geochemical studies thus allow judgments to be made concerning the tectonic structure of the rift zone and the hydrologic conditions in the basin. The tectonic activity of the rift structure varies along its length, the variation being precisely expressed in the specifics of the gas released by the lithosphere. Figures 1; references 9: 8 Russian, 1 Western.  
[32-6508]

UDC 555.462(267)

#### SPECIFICS OF STRUCTURE OF RELIEF IN AUSTRALIAN-ANTARCTIC SECTOR OF INDIAN OCEAN

Moscow OKEANOLOGIYA in Russian Vol 24, No 4, Jul-Aug 84  
(manuscript received 23 May 83; after revision 29 Dec 83) pp 649-655

KUZ'MICH, I. A., Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences, Moscow

[Abstract] A description is presented of the structure of the relief in the Australian-Antarctic area of the Indian Ocean. The most significant peculiarity of this area is the great increase in mean depth in its central portion. The increase in depth is seen both within the central ridge and in the adjacent part of the deep-water trenches. The depth increase in the central portion of the region is 600 to 800 m in comparison to the general depth level. The central portion of the region of anomalous depth falls within a unique bottom morphostructure, the Australian-Antarctic nonconformity, which has no analog in other areas of the ocean. Located between 120 and 128° E, this area features greatly broken relief. A diagram of sonar profiles used to analyze relief of the area is presented. Graphs illustrate the variation of relief dissection with rate of spreading. The degree of relief dissection, or morphometric characteristics, is suggested

as an objective criterion. Medium-scale dissection on the flanks of the ridge correlates with the spreading rates. Figures 5; references 18: 4 Russian, 14 Western.  
[32-6508]

UDC 550.361(536.66)

IT-1 DIGITAL DEVICE FOR MEASURING THERMAL CONDUCTIVITY OF NONCONSOLIDATED  
BOTTOM SEDIMENTS

Moscow OKEANOLOGIYA in Russian Vol 24, No 4, Jul-Aug 84  
(manuscript received 4 May 82) pp 706-708

ARTEMENKO, V. I., SEL'YANINOV, V. G. and LEBEDEV, A. I., Ocean Geophysics  
Scientific Research and Production Institute, Gelendzhik

[Abstract] The IT-1 thermal conductivity measuring device was developed at the laboratory of Marine Thermal Prospecting, "Yuzhmorgeologiya" Production Association, using digital elements and a BZ-14M solid-state calculator. The device allows automation of the process of measurement by hardware implementation of the algorithm for computation of the thermal conductivity coefficient by the needle probe method. A block diagram and photograph of the IT-1 are presented. The sensor is a thin hollow needle with a heater and thermocouple. The operation of the device is explained. The IT-1 can be used by nontechnical operators and can be used on ships as geological samples are brought up from the bottom. Figures 2; references 4: 3 Russian, 1 Western.  
[32-6508]

UDC 551.460

NINTH CRUISE OF SCIENTIFIC RESEARCH VESSEL 'PROFESSOR SHTOKMAN' (EXPEDITION  
TO AMAZON)

Moscow OKEANOLOGIYA in Russian Vol 24, No 4, Jul-Aug 84 pp 713-717

GORDEYEV, V. V.

[Abstract] The 9th cruise of the "Professor Shtokman" was organized by the Oceanological Institute imeni P. P. Shirshov, USSR Academy of Sciences for the conduct of oceanographic studies in the lower Amazon River and adjacent regions of the Atlantic Ocean. The major task of the cruise consisted of biogeochemical, sedimentological, optical and biological studies of the effluent of the world's largest river and an estimate of its influence on processes occurring in the adjacent Atlantic. Another important task was

establishment of scientific contacts with Brazilian scientists. A special decree was signed by the President of Brazil allowing the Soviet expedition to operate in Brazilian waters from February through April of 1983. Maps show the track followed on the cruise, location of stations where measurements were made in the Amazon basin and the location of stations in the adjacent Atlantic Ocean. Figures 3.  
[32-6508]

UDC 550.373

#### METHOD OF MEASURING ELECTRIC FIELDS AT SEA IN SLF BAND CONSIDERING PRIMARY CONVERTER NOISE

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 24, Jul-Aug 84  
(manuscript received 12 Jul 83) pp 662-666

ZIMIN, Ye. F., KASPARYAN, V. G., KOCHANOV, E. S. and MIRZOYAN, G. A.

[Abstract] A description is presented of a method of measuring the electric field in the ocean considering both thermal and induced electrode noise. This noise is considered by using a system consisting of two channels, with the second channel containing an electrode pair with measurement electrodes located so close to each other that the channel becomes insensitive to the applied electric field, since the external conditions for the two electrodes are virtually identical. The circuit also includes an additional noise channel to determine the noise level in the measurement area. The level of induced electrode noise increases greatly with an increase in wave action at sea. Precision measurement of the variable electric field at sea requires the use of the additional zero-base measurement channel with an impedance equal to the impedance of the measurement electrodes. Figures 3, references 11: 4 Russian, 7 Western.  
[99-6508]

UDC 550.385.1

#### ANOMALOUS ELECTROMAGNETIC FIELDS AND ELECTROMAGNETIC SEA-FLOOR SOUNDINGS

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 24, Jul-Aug 84  
(manuscript received 15 Jun 83) pp 667-673

BERDICHEVSKIY, M. N., ZHDANOVA, O. N. and YAKOVLEV, A. G., Moscow State University

[Abstract] This article presents a comparative analysis of oceanic and continental electromagnetic field anomalies and describes the results of model



testing of instrumentation for magnetotelluric and magnetic variation soundings in a sea with a nonsmooth bottom. Two-dimensional continental and oceanic models are analyzed. The continental model consists of three layers imitating the sediments, poorly conducting crust and upper mantle and the deep conducting zone. The problem is solved in a quasisteady approximation with an external field consisting of H and E polarized waves. The frequencies studied are in the S and H intervals. Analysis of the models indicates broad practical capabilities of marine geoelectric studies. The geoelectric heterogeneity of the bottom virtually does not distort the results of soundings performed by magnetotelluric or magnetic variation methods. Marine geoelectric studies are thus more promising than continental studies.

Figures 5; references 8: 5 Russian, 3 Western.

[99-6508]

UDC 552.1:539.89

MORE PRECISE CURVE OF DEPENDENCE BETWEEN DENSITY AND VELOCITY OF LONGITUDINAL WAVES IN CONSOLIDATED CRUST AND TOP OF MANTLE IN OCEANIC STRUCTURES

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR. SERIYA B: GEOLOGICHESKIYE, KHIMICHESKIYE I BIOLOGICHESKIYE NAUKI in Russian No 5, May 84  
(manuscript received 7 Jul 83) pp 21-24

RUSAKOV, O. M., Geophysics Institute, Ukrainian Academy of Sciences, Kiev

[Abstract] The correlation dependence  $\rho = f(V_p)$  is universally used in determining the density of the consolidated oceanic crust on the basis of the velocity of propagation of seismic waves. However, the procedure for deriving the correlation between  $\rho$  and  $V_p$  cannot be considered correct. First, the range of rocks used in deriving the dependence did not include all the types of rocks which according to present-day data make up the bottom of the crust and the top of the mantle. (Accordingly, the velocity of the longitudinal seismic waves in the studied samples did not exceed 7.16 km/sec.) Second, for half the samples the values of the parameters were grouped in a narrow range (density in the range  $2.65-2.9 \cdot 10^3$  kg/m<sup>3</sup>, velocity in the range 5.5-6.5 km/sec). Third, the least squares method used in the analysis gives fictitious results. As a result of the incorrect procedure for deriving the formula the latter gives adequate  $\rho$  values only in a limited region. For example, the mean velocity of layer 3 of the oceanic crust, equal to 6.73 km/sec, corresponds to a density of  $3.08 \cdot 10^3$  kg/m<sup>3</sup>. For this reason it is necessary to construct a curve which correctly reflects the correlation between velocity and density for the entire consolidated crust and upper mantle. The author used 735 determinations of  $\rho$  and  $V_p$  in constructing this curve. In contrast to the earlier work, the samples constituted a full range of rock types for the consolidated crust and top of the mantle. Assuming the mean velocity at the Moho is 8.13 km/sec, the density of the top of the mantle obtained from the curve is  $3.29 \cdot 10^3$  kg/m<sup>3</sup>,

which agrees with modern concepts concerning the composition of the sub-crustal layer of oceanic basins. The density column of the consolidated crust is as follows: thickness of layer 2--1.3 km, density-- $2.5 \cdot 10^3$  kg/m<sup>3</sup>; layer 3--4.8 km and  $2.9 \cdot 10^3$  kg/m<sup>3</sup> respectively. Figures 1, tables 2; references 11: 2 Russian, 9 Western.  
[206-5303]

UDC 553.435:551.35

#### MINERALIZATION CONDITIONS AT SEA

Novosibirsk TIKHOOKEANSKAYA GEOLOGIYA in Russian No 3, May-Jun 84  
(manuscript received 1 Nov 83) pp 121-125

VLASOV, G. M. Tectonics and Geophysics Institute, Far Eastern Scientific Center, USSR, Academy of Sciences, Khabarovsk

[Abstract] Publication of this article was stimulated by texts of two articles provided by A. Malahoff, an American scientist who has studied sulfide ores on the Pacific Ocean floor. The massive sulfide ore deposit north of the Galapagos rift system is described. Rift systems are frequently highly ore productive. Strong hydrothermal processes accompanying pyrite, pyrite-polymetallic and other ore formation in such areas may mobilize large masses of iron and manganese from volcanic rock, causing the formation of individual deposits of iron and manganese ores. As silicon-consuming organisms develop, the iron and manganese is bonded with silica gel, yielding iron-silicon and manganese-silicon rock, frequently in common bodies. When a shortage of silicon developed in the ocean, the iron and manganese can migrate further from their points of formation, manganese usually moving further than iron. Manganese is precipitated as nodules, which are now found on the sea floor in areas rather far from centers of volcanic activity. References 20: 16 Russian, 4 Western.  
[18-6508]

UDC 621.391.826:550.8.08

#### MEASUREMENT COMPLEXES FOR GEOPHYSICAL STUDIES AT SEA

Novosibirsk TIKHOOKEANSKAYA GEOLOGIYA in Russian No 3. May-Jun 84  
(manuscript received 5 Apr 83) pp 115-117

VERZHBITSKIY, Ye. V., Oceanology Institute, USSR Academy of Sciences, Moscow

[Abstract] A study is made of the principles of design of geophysical measurement systems for the study of bottom relief, magnetic fields and heat

flows in the ocean. The noise caused by the passage of the ship's hull through the ocean can be reduced by towing measurement instruments at some depth and separation from the wake. However, this reduces directionality. A receiving system performing asynchronous accumulation of echo signals of several towed antennas achieves some directionality. The creation of multiple element towed systems with precision recording devices can greatly increase the quality of depth measurements. Multiple channel heat measurement devices can supplement the information provided by sonar arrays with thermal gradient measurements. Such complex systems of measurement devices can increase the information content of scientific data obtained in studies of structure of the ocean floor by the combination of sonar, magnetic field and heat flow measurements. References: 7 Russian. [18-6508]

UDC (550.831+550.838):551.24(26)

#### CRUSTAL AND UPPER MANTLE DENSITY MODEL OF OWEN FAULT ZONE

Kiev GEOFIZICHESKIY ZHURNAL in Russian Vol 6, No 3, May-Jun 84  
(manuscript received 25 Jan 83) pp 51-57

[Author not listed]

Geophysics Institute, Ukrainian Academy of Sciences; Yuzmorgeologiya  
(Southern Marine Geology) Production Association, Gelendzhik

[Abstract] The Owen fault zone extends parallel to the Arabian and African coast for 3,000 km. Its strike is 50-55°. The zone consists of four main parts: active, Chain, Owen and Murray ridges. Almost along the entire extent of the fault there is an asymmetry of bottom relief (one of the slopes of the ridges adjacent to the depression is always steeper). New data have been obtained making possible a more detailed description of the density structure of the fault zone. A systematic geophysical survey was made which took in virtually the entire Owen zone. The gravity field was interpreted along 16 profiles (as indicated in Fig 1). Six characteristic density sections (of the 19) are examined in this article; Fig 2 gives examples of interpretation profiles across the fault zone. A whole series of important conclusions could be drawn concerning the density structure on the basis of an analysis of the anomalous gravity field. Along the entire fault zone, including its active part, there is a mass deficit; the width of this zone is about 50 km. The lack of seismic data on the M discontinuity makes it impossible to give specific reasons responsible for the negative difference anomalies. The identified negative residual anomaly is strictly confined to marginal areas of the zone and cannot be attributed solely to crustal inhomogeneities. It is postulated that there may be weakened regions in the lithosphere associated with the fracturing of rocks and intensive serpentization. The zone of rocks of reduced density probably lies in the crust and directly below the M discontinuity. Figures 2; references 17: 8 Russian, 9 Western. [217-5303]

UDC 611.2:551.4

INFLUENCE OF DEGREE OF EXPOSURE OF HORIZON ON CHANGES IN DIRECT RADIATION  
UNDER COMPLEX RELIEF CONDITIONS

Leningrad IZVESTIYA VSESOYUZNOGO GEOGRAFICHESKOGO OBSHCHESTVA in Russian  
Vol 116, No 4, Jul-Aug 84 (manuscript received 11 Apr 83) pp 337-341

PIGOL'TSINA, G. B.

[Abstract] Moments of appearance and disappearance of the sun are determined on slopes of 8 exposures with steepnesses 10, 20, 30 and 40° at latitudes 6-70°N during the warm season (April through September) and the changes in times of sunrise and sunset on these slopes (in minutes) relative to a horizontal surface, i.e., the decrease in time of irradiation of the slopes is determined. The time of sunrise and sunset on the slopes was determined by a graphic method. The coefficients for transition from radiation striking a horizontal surface to that striking a vertical surface were calculated on a BESM-6 computer. The results produced allow the true conditions of irradiation of slopes to be estimated under complex relief conditions. Figures 3; references: 5 Russian.  
[45-6508]

INTERNATIONAL COOPERATION IN THE STUDY OF MIDDLE ATMOSPHERE

Moscow ZEMLYA I VSELENNAYA in Russian No 4, Jul-Aug 84, pp 72-77

DANILOV, A. D., doctor of physical mathematical sciences

[Abstract] Some 10 years ago the author of this article and other scientists appealed to a number of international organizations to undertake a scientific program called the Middle Atmosphere Program or MAP. A number of organizations have supported the suggestion and scientific studies are underway. This article discusses the structure of the middle atmosphere, encompassing the upper troposphere through the lower thermosphere, including all of the stratosphere and mesosphere. The goals of MAP are to study the structure and physics of the middle atmosphere to answer such great questions as the fate of the ozone layer and the influence of the sun on weather.



Tasks include global studies of related phenomena. The cooperation of international specialists in this effort is emphasized. The MAP program is presently in its culmination, and it is still too early to draw conclusions or list final results. Figures 2.

[22-6508]

UDC 551.501.724:551.501.75:551.596.1

RADOSODAR SYSTEM FOR REMOTE SYNCHRONOUS MEASUREMENTS OF WIND SPEED,  
TEMPERATURE AND ITS FLUCTUATIONS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 20, No 8 Aug 84 (manuscript received 24 Feb 83) pp 770-772

PETENKO, I. V. and SHURYGIN, Ye. A., Atmospheric Physics Institute,  
USSR Academy of Sciences

[Abstract] The term radiosodar refers to simultaneous acoustical and radio-acoustical soundings combined with a sodar anemometer. It includes an installation for radioacoustical soundings for determination of temperature  $T$ ; a vertical Doppler sodar for measurement of  $C_T$  and the vertical wind speed component  $w$ ; and two slant Doppler sodars for determination of the two horizontal components of wind speed. A functional diagram of the radiosodar is presented and briefly discussed. Examples of vertical temperature,  $C_T$  and wind speed are presented with echograms of the acoustical signals simultaneously measured. The system was tested in the fall of 1982 with antennas installed on the roof of a two-story building. Collection, processing and output of data requires about 8 minutes. Software control allows selection of the necessary number of points in each profile before it is measured. Simultaneous and rapid measurements of vertical profiles of temperature, wind speed and  $C_T$  using the radiosodar system opens new possibilities for weather observations and the solution of geophysical problems of modeling and parametrizing the atmospheric boundary layer. Figures 2; references 14: 10 Russian, 4 Western.

[55-6508]



UDC 551.501.7:625.723

POSSIBILITY OF DETERMINING ATMOSPHERIC WEATHER PARAMETERS BY RADIO AND  
RADIOOPTICAL MEASUREMENTS OF REFRACTION OF COSMIC SOURCES

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 20, No 8 Aug 84 (manuscript received 20 Jan 83; after revision 5 May 83)  
pp 675-682

GAYKOVICH, K. P., Gorkiy Radio Physics Scientific Research Institute

[Abstract] Joint measurements of optical and radio refraction within the atmosphere can be used to provide data on density and moisture content profiles of the atmosphere through which the rising and setting of celestial bodies is observed. Numerical experiments were performed to determine model profiles for use in such experiments. Calculations were performed in a closed system in which refraction calculated for model profiles was used to retrieve the E, T and P profiles, which corresponded quite accurately to the initial model profiles. Errors were assigned using a random number generator and the corresponding errors in meteorological parameters were calculated. It was found that errors in computing the index of refraction are proportional to the relative error in measurement of refraction. Studies were performed both for measurement of refraction from an elevation of 500 m and measurement of refraction from space. The presence of vertical autocorrelations among meteorological parameters can in principle be used to increase the accuracy of results still further. Figures 3; references: 6 Russian.  
[55-6508]

UDC 551.521.2:551.510.42

INFRARED AEROSOL ABSORPTION INDEX

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 20, No 8 Aug 84 (manuscript received 19 Apr 83) pp 715-724

GABELKO, L. B. and LYUBOVTSOVA, Yu. S., Atmospheric Physics Institute,  
USSR Academy of Sciences

[Abstract] The imaginary portion of the complex index of refraction of aerosol particles  $\kappa_{\text{aer}}$  is determined using data on simultaneous chemical and optical (infrared transmission spectra) analysis of aerosol specimens. The IR absorption spectra of aerosol samples are used to determine the basic absorption bands of the aerosol and its molecular composition, the major chemical compounds or functional groups which contribute to absorption.  $\kappa(\lambda)$  is computed for the absorption bands from chemical analysis data considering the weight contribution of absorbing compounds to the total

mass of the particle. Values of  $\kappa_{\text{opt}}(\lambda)$  are also calculated from the infrared absorption spectra. To do this, the IR spectra are used to determine the coefficient of aerosol absorption  $\alpha(\lambda)$ ; then the Rayleigh equation is used to determine  $\kappa_{\text{opt}}(\lambda)$ . Specimens collected in the Abastumani Mountains at an elevation of about 2000 m and in the city of Moscow were used in the studies. Values of  $\kappa_{\text{org}}$  were calculated based on mass spectrometer data. The organic fraction makes a significant contribution to absorption in the IR band. The  $\kappa_{\text{org}}$  value is comparable to  $\kappa_{\text{carbon}}$  and  $\kappa_{(\text{NH}_4)_2\text{SO}_4}$  in the absorption bands. Values of the absorption index are presented for the submicron fraction of natural and urban aerosols. Aerosol absorption in the IR range is found to be determined by the submicron aerosol fraction. Figures 3; references 17: 7 Russian, 10 Western.  
[55-6508]

UDC 551.71/.72.03(470.21/23)

STUDY OF STRATIGRAPHY OF THE PRECAMBRIAN SOVIET BALTIC SHIELD

Moscow SOVETSKAYA GEOLOGIYA in Russian No 7, Jul 84 pp 105-118

KRATS, K.O., deceased (Geology and Geophysics Institute, USSR Academy of Sciences), NEGRUTSA, V.Z., "Sevzapgeologiya" Production Association, SOKOLOV, V.A., Karelian Branch, USSR Academy of Sciences, BOGDANOV, Yu.B., All-Union Scientific Research Institute of Geology, GASKEL'BERG, V.G., "Sevzapgeologiya" Production Association, ZAGORODNYY, V.G., Geology Institute, Kola Branch, USSR Academy of Sciences, NEGRUTSA, T.F., Leningrad State University, SEMIKHATOV, M.A., Geology Institute, USSR Academy of Sciences and SHURKIN, K.A., Precambrian Geology and Geochronology Institute, USSR Academy of Sciences

[Abstract] Studies of the stratigraphy of the Precambrian Soviet Baltic shield have been undertaken by a consortium of the institutes and organizations represented by these authors. All the work has proceeded in accordance with the stratigraphic codex of the USSR considering past experience and methodological requirements on the development of stratigraphy. A summary simplified model of regional stratigraphic systems of Precambrian deposits in the Soviet Baltic shield is presented in tabular form and the subdivisions used are explained. Definitions are given for each of the major strata distinguished in the plan. Suggestions are made for future improvements in the stratigraphic plan. References 19: 17 Russian, 2 Western.

[34-6508]

## INTENSIFICATION OF UTILIZATION OF MINERAL RESOURCES

Moscow SOVETSKAYA GEOLOGIYA in Russian No 7, Jul 84 pp 70-78

GINZBURG, A.I., YEREMEYEV, A.N., OSTROUMOV, G.V., All-Union Institute of Mineral Resources

[Abstract] Intensification of the utilization of mineral resources can be achieved by three means: 1) extraction of the maximum possible quantity of raw materials by increasing extraction of all components and their combined utilization; 2) reevaluation of deposits already mined which were considered exhausted at one time; 3) use of new types of mineral raw materials. The basis for increasing extraction and development of waste-free technology includes detailed studies of the mineral composition of deposits, comparative studies of properties of minerals found in association, establishment of means for directed alteration of properties to allow most complete possible separation, determination of forms of inclusions of elements in minerals and studies of their behavior in technological processes. Utilization of exhausted or ostensibly nonproductive deposits requires the application of all methods mentioned above for increasing extraction, as well as the use of new geotechnological methods for working of deposits, joint utilization of numerous closely located deposits, the exploitation of tailings and various products accumulated at depleted and producing enterprises and the development of small, relatively rich deposits. Industrial utilization of new types of mineral raw materials must include the utilization of such minerals as dawsonite and other aqueous aluminum carbonates, iron hydrostanates, tungstenite, tungsten-containing oxides of manganese, birnessite and vernadite, mercury-containing sphalerite, baddeleyite, kularite, aqueous calcium and magnesium borates and cryolite, among many others. Study of a number of poorly known properties such as elastic, acoustical, thermal, electrophysical, photoelectric, ion exchange, catalytic, radiation and other properties will allow these to be used to improve separation and refinement. References:

15 Russian.

[34-6508]

## OBSERVATION OF LONG-PERIOD OSCILLATIONS OF EARTH

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 8, Aug 84  
(manuscript received 12 Aug 83) pp 3-12

SAVINA, N.G., TIPISEV, S.Ya., LIN'KOV, Ye.M. and YANOVSKAYA, T.B.,  
Leningrad State University; Seismic Station, Pulkovo

[Abstract] Results are presented from analysis of steady observations performed on the Leningrad State University long-period seismometric channel covering periods of 4 to 300 minutes. In addition to studying the spectral composition of long-period oscillations, the relationship of these oscillations with earthquakes was investigated. Attempts were made to protect the seismograph from and compensate for variations in atmospheric pressure and temperature, standing waves in the Gulf of Finland and other possible interference. A strong earthquake occurred on 25 May 1981 during the time when the long-period channel was continuously recording. Comparison of the results of statistical analysis of long-period oscillation spectra recorded by the modified long-period channel and the low frequency spectrum following the earthquake of 25 May 1981 with the results of previous investigations shows that the spectral composition of the seismic oscillations with periods of 58 to 100 minutes is stable. The amplitude of superlong-period oscillations is comparable to the amplitude of the basic spheroidal tones of the natural oscillations of the earth. Based on analysis of records before and after the earthquake of 25 May 1981 it is shown that superlong-period oscillations can be excited by strong earthquakes. There is a constant background of long-period oscillations with intensity varying with time apparently maintained by frequent moderately strong earthquakes. The excitation of such oscillations is probably facilitated by the presence of a long-period component in the spectrum of radiation from an earthquake focus. Figures 5; references 22: 14 Russian, 8 Western.  
[40-6508]

UDC 550.34.013.4

## NUMERICAL MODELING OF PLANE STICK-SLIP FAULT

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 8, Aug 84  
(manuscript received 23 Mar 83) pp 13-21

AREF'YEV, S.S. and GRAYZER, V.M., USSR Academy of Sciences, Earth Physics  
Institute imeni O.Yu. Shmidt

[Abstract] A numerical study is presented of differences in movements from complex and simple faults. Based on a dislocation model of a focus, the displacements near a complex fault consisting of several smooth sections are calculated. The kinematic approach used allows calculation of the



radiation from a complex fault without studying the causes of delays and interruptions in the process of movement of the fault. The possibility is shown of modeling a fault of the stick-slip type, assumed to consist of several straight dislocations. Displacements from smooth and complex faults are compared, varying the pairing rate and displacement step at the fault for constant seismic moment. It is shown that the amplitude of displacements from a source of the second type is greater than from one of the first. The reasons for this increase include the discreteness of the fault and the variation in displacement in its sectors. It is shown that the displacement spectra from smooth faults and stick-slip faults are different. Model calculations are compared with seismic observations and laboratory experiments. Figures 5; references 19: 9 Russian, 10 Western. [40-6508]

UDC 550.348.098.2

#### KINEMATIC FEATURES OF P-WAVES FOR ARMENIAN UPLAND EARTHQUAKES

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 8, Aug 84 (manuscript received 15 Mar 82) pp 67-71

KONDORSKAYA, N.V., and SAAKYAN, A.A., USSR Academy of Sciences, Earth Physics Institute imeni O.Yu. Shmidt; Geophysics and Engineering Seismology Institute, Armenian Academy of Sciences

[Abstract] A method is tested for systematizing the kinematic parameters of P-waves for Armenian upland earthquakes recorded by seismic stations in the Caucasus. The method is a multistage cycle of studying the specifics of the travel-time curve of the P-wave as applicable to solution of the problem of determining the coordinates of hypocenters of earthquakes based on observations of stations within 600 km and to produce detailed data on the crustal structure. A specific feature of the method is that it allows utilization of earthquake data for which the depth of the hypocenter is not known in advance. The cycle allows accumulation of the necessary seismic data on P-wave travel time for subsequent detailization of the structure of the Caucasus crust. The method can be used for other seismically active regions as well. Figures 3; references 15: 13 Russian, 2 Western. [40-6508]

## SCATTERING OF ELASTIC WAVES ON FRACTURES RANDOMLY DISTRIBUTED IN A THREE-DIMENSIONAL MEDIUM

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 8, Aug 84  
(manuscript received 12 Jan 83) pp 72-77

STRIZHKOV, S.A. and PONYATOVSKAYA, V.I., Earth Physics Institute imeni  
O.Yu. Shmidt, USSR Academy of Sciences

[Abstract] The purpose of this work is to determine the variation in basic characteristics of the wave field formed in a jointed medium, such as the intensity of fluctuations of amplitude, correlation radius, scattering coefficient and frequency composition of waves, as functions of jointing parameters. Fractures are simulated by flat plates randomly distributed and chaotically oriented in a three-dimensional medium. Experiments were performed using an alabaster model, a rectangular block measuring 50 x 50 x 120 mm. Homogeneous models and models containing fractures simulated by 0.1 mm plates of aluminum foil were used. The plates were introduced into liquid alabaster which was then agitated. Models made in this way contain randomly distributed and chaotically oriented fractures. The influence of these fractures appears as fluctuations in the wave field formed in the medium. The data obtained in experimental studies showed that the dimensions of heterogeneities determined by waves in the jointed medium and the dimensions of the fractures themselves coincide only if the distance between fractures is rather great. If the distance between fractures is less than the wavelength, the dimensions of the heterogeneities located by the wave depend on wavelength. Anomalous scattering appears in that the scattering coefficient decreases with an increase in frequency. The moment of transition from normal to anomalous scattering can serve as a characteristic of the density of fractures, which can be used to estimate the degree of jointing both in laboratory studies with specimens which are fractured and in field studies of the process of earthquake preparation. It was found that in areas of normal scattering, the scattering coefficient increases with frequency less sharply than predicted by the theory of scattering on weak heterogeneities. A similar result was obtained in studies of the variation of scattering coefficient as a function of frequency in the field. Figures 5; references: 5 Russian.

[40-6508]

# **P-WAVES AND FOCAL PARAMETERS OF DEEP-FOCUS EARTHQUAKES IN THE FIJI-TONGA REGION**

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 7, Jul 84  
(manuscript received 11 Nov 83) pp 38-54

MOSKVINA, A.G., Earth Physics Institute imeni O.Yu. Shmidt, USSR Academy of Sciences

[Abstract] A study is made of earthquakes from a single region, the Fiji-Tonga depression. Forms of pulses in the P-wave and such parameters of the foci as dimensions, rate of pairing, overthrust and seismic moments are determined. The results obtained allow some conclusions to be drawn concerning the nature of the focal process. The true movement of the soil in the P-wave is established for 11 deep-focus earthquakes and by correction for the medium the signal is reduced to the focus. The signal is a single monopolar pulse of near-triangular shape indicating that a circular flat smoothly expanding dislocation is a good model of a focus. Three methods are tested for determining focal parameters: spectral, pulse-shape analysis and calculation of theoretical seismograms. None of these methods yields systematic error. Focal parameters are determined for 8 earthquakes. The seismic moments of the earthquakes were approximately 1 to 1.5 orders of magnitude higher than  $M_0$  determined for surface foci of the same magnitude. A decrease is found in the rate of pairing of fractures with increasing magnitude of the event. As the energy of an earthquake increases, shifting of fracture edges increases much more than the linear size of the focus, indicating that the dynamic similarity condition is not met for deep earthquakes. Figures 5; references 20: 15 Russian, 5 Western.  
[43-6508]

UDC 537.226+550.344.098

# **NATURAL ELECTROMAGNETIC RADIATION IN SEISMICALLY ACTIVE REGIONS**

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 7, Jul 84  
(manuscript received 25 May 82) pp 55-63

MIGUNOV, N.I., SOBOLEV, G.A. and KHROMOV, A.A., Earth Physics Institute imeni O.Yu. Shmidt, USSR Academy of Sciences

[Abstract] A study is made of results of investigations performed using direction-finding apparatus determining the direction of arrival of electromagnetic signals with an accuracy to three degrees. The arrival time of signals is recorded with an accuracy to 1 ms. Analysis of the signal shape allows computation of the distance to the signal source. The results of observations do not prove the existence of changes in electromagnetic radiation during earthquakes, but do make this assumption seem likely. A promising trend for further research is a changeover to active methods for

studying mechanoelectrical phenomena and conditions for propagation of radio waves in seismic regions. Combined studies including seismoelectric soundings of the crust and radio transillumination of the atmosphere are worth pursuing. The lack of a reliable method for short-term prediction of earthquakes makes a study of electromagnetic precursors interesting. Figures 5; references 18: 14 Russian, 4 Western.  
[43-6508]

UDC 550.831+550.834:001.8

DETERMINATION OF DENSITY OF THE CRUST AND UPPER MANTLE FROM DEEP SEISMIC SOUNDING AND GRAVIMETRY. II

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 7, Jul 84 (manuscript received 29 Sep 83) pp 64-80

ROMANYUK, T.V. and STRAKHOV, V.N., Earth Physics Institute imeni O.Yu. Shmidt, USSR Academy of Sciences

[Abstract] Part I of this work outlined the methodology of combined interpretation of deep seismic sounding data and gravimetry and presented equations for determining the density of a cross section based on field  $\Delta g$  and the velocity cross section. This portion of the work studies a number of purely methodological problems, develops computer programs for simple situations in which density does not fluctuate within individual blocks and presents results of model calculations. The purpose of the calculations was to provide a quantitative estimate of the difficulty in retrieval of cross-section density when background components are present in the  $\Delta g$  field and there are rather intense "medium-frequency" noises simulating the influence of unknown large density heterogeneities in the upper portion of the cross section. The accuracy of solution of the problem depends on a number of factors including the nature of the velocity cross section, the type of noise and its intensity and the width of the boundary of limitations on branches and gradients of density. The influence of both the background field and high-frequency noise on accuracy of density retrieval is not great. Limitation on the values of the functions  $\rho = f(v)$  and its gradients and the requirement of a monotonic nature on these functions greatly increases the stability of the solution. In favorable cases, density can be retrieved with a mean square error on the order of 0.01-0.02 g/m<sup>3</sup>. The most important conclusion is that the use of the  $\rho = f(v)$  equation cannot support selection of a field with the required accuracy. Consequently, the concept of the presence of fluctuations in density through the cross section must be accepted and gravitational modeling of errors in seismic constructions with simple layers must be undertaken. Figures 6; references : 10 Russian.  
[43-6508]



## INDUCTION EXCITATION OF DEEP CONDUCTING ZONES

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 7, Jul 84  
(manuscript received 5 Jan 82) pp 85-89

BERDICHEVSKIY, M.N., BILINSKIY, A.I., KOBZOVA, V.M., and MOROZ, I.P.,  
Moscow State University; Applied Problems of Mechanics and Mathematics  
Institute, Ukrainian Academy of Sciences

[Abstract] New data are published on induction excitation of deep conducting zones. Data were obtained at the Applied Problems of Mathematics and Mechanics Institute on a physical modeling installation using an electrolytic bath in combination with metal shields. Physical modeling shows that the induction mechanism of excitation of deep conducting zones can make a more or less significant contribution to magnetotelluric sounding curves. A zone measuring 2 and 5 times its depth in the vertical and horizontal directions can be taken as the threshold zone. If a conducting zone 20 km thick lies at a depth of 10 km and extends for hundreds of kilometers, the MT curve may be deflected from the normal by tens of percent. The conducting asthenospheric zone should appear in MT curves if its thickness reaches 150-200 km and it extends for 1,000 or more kilometers. The major difficulty is that induction excitation of isolated conducting zones does not fall within the framework of the Tikhonov-Cagniard model, and interpretation of MT curves must be accomplished in a class of three-dimensional models. Figures 2; references: 8 Russian.

[43-6508]

## STUDY OF RESOLUTION OF DEEP MT SOUNDINGS BY MEANS OF PHYSICAL MODEL

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 7, Jul 84  
(manuscript received 5 Jan 82) pp 85-89

BERDICHEVSKIY, M.N., BILINSKIY, A.I., KOBZOVA, V.M., MOROZ, I.P., Moscow  
State University; Applied Problems of Mechanics and Mathematics Institute,  
Ukrainian Academy of Sciences

[Abstract] Two problems are studied: 1) the influence of deep fractures through which conductive redistribution of current occurs; 2) the excitation of deep conducting zones by an anomalous magnetic field of near-surface origin. Both problems are studied by means of a physical installation created at the Applied Problems of Mechanics and Mathematics Institute. The installation consists of an electrolytic bath, a system of metal shields and frame antenna forming a quasihomogeneous field. A simple three-dimensional model is studied yielding a qualitative concept of the influence of fractures. Model MT curves are presented obtained over the center of a metal disk which lies at the bottom surface of a conducting layer (the electrolyte) which is over a poorly conducting layer and another



conducting layer. The model merely indicates that fractures, even if rather small, cause deep conducting zones to be accessible for MT soundings. Formal, one-dimensional interpretation of MT curves may thus lead to serious errors, but allow at least qualitative detection of deep conducting zones. Reliable quantitative interpretation requires analysis of two-dimensional and three-dimensional models. The theory of deep MT soundings should be oriented primarily on a study of the mechanism of galvanic excitation of crust and mantle conducting zones. Figures 3; references:

7 Russian.

[43-6508]

UDC 550.834

#### NATURE OF SEISMIC IMAGES WITH AMPLITUDE AND TIME FLUCTUATIONS OF RECORDED OSCILLATIONS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 7, Jul 84 (manuscript received 30 Sep 80) pp 90-97

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[Abstract] The following problem is solved: suppose a wave  $f_0(x_0, y_0, t)$  is reflected from a flat horizontal boundary is recorded at the flat horizontal surface of the earth  $z = 0$ . The boundary is assumed absolutely reflecting and constant in its physical properties. The process of formation of the seismic image at depth  $z$  in a homogeneous isotropic absolutely elastic space based on the wave field fixed at the surface is described by a focusing integral transform. The situation is complicated by amplitude distortions and time shifts of the recorded wave. The purpose of the work is to study the influence of these types of noise on the nature and quality of images produced and to estimate the admissible value of dispersion  $A(x_0, y_0)$  and  $\delta t(x_0, y_0)$  which will still allow correlation of horizons or isolation of anomalies in dynamic parameters on the images. It is concluded that as seismic holographic images are formed the presence of amplitude and time fluctuations in the recorded field resulting from variability in conditions of wave reception leads to amplitude-phase fluctuations of images, the appearance of false synphase axes of various extent, deterioration of quality of sections to the point of complete loss of the correlation of the horizons studied. The introduction of a simple model of a statistically homogeneous isotropic field of amplitude and time fluctuations in recorded isolations shows the influence of small- and large-scale heterogeneities of reception conditions of the mathematical expectation, dispersion and radii of longitudinal and transverse correlation of noise on images. The relationship between mathematical expectation and dispersion of frequency characteristics of formation of the seismic image and characteristics of amplitude and time fluctuations in the recorded field is obtained. References 13: 12 Russian, 1 Western.

[43-6508]

UDC 550.340

#### SPACE AND TIME DISTRIBUTION OF AFTERSHOCKS

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 8, Aug 84 (manuscript received 8 Jul 83) pp 108-117

ZHALKOVSKIY, N.D. and MUCHNAYA, V.I., Geology and Geophysics Institute, Siberian Branch, USSR Academy of Sciences, Novosibirsk

[Abstract] The purpose of this work is to refine the equations used to determine the distribution of aftershocks in space and time and on their basis to determine whether the growth of the number of aftershocks with an increase in earthquake magnitude is related solely to an increase in the volume of the area occupied by the hypocenter or whether the degree of activation of the area also depends on the earthquake magnitude. The results show that an increase in the number of aftershocks with increasing seismic moments of an earthquake is fully defined by the increase in volume of the area over which they extend. In other words, the degree of activation of the area of an aftershock is not dependent on the magnitude of the earthquake itself. The earthquake magnitude also does not influence attenuation of the frequency of development of aftershocks over time. Figures 4; references 30: 12 Russian, 18 Western.  
[114-6508]

UDC 528.2[52-77+620.27]

#### DETERMINING VECTOR OF RADIOINTERFEROMETER BASE FROM OBSERVATIONS OF NATURAL RADIO EMISSION WITH NARROW SPECTRUM

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEODEZIYA I AEROFOTOS"YEMKA in Russian No 2, Mar-Apr 84 (manuscript received 11 Jan 82) pp 9-13

SHANUROV, G.A., docent, candidate of technical sciences, Moscow Order of Lenin Institute of Geodetic, Aerial Mapping and Cartographic Engineers

[Abstract] Radiointerferometry with a very long base makes it possible to determine the vector of a base with a length of several thousand kilometers with an error not exceeding 10 cm and the angular parameters with an error of about 0.001". Regional geodetic networks, such as for measuring crustal deformations, can be constructed using 4- and 9-m mobile antennas operating together with a 60-m antenna. The measured parameters are the time lag in arrival of the wave front at one station relative to another and the interference frequency  $f$ , related to the lag  $\tau$  by the expression  $f = v \cdot \partial \tau / \partial t$  ( $t$  is time,  $v$  is radio frequency). Highly precise  $\tau$  measurement is

possible only with a width of the reception and signal registry band of hundreds of MHz. The results of  $f$  measurement contain no information on the polar component  $\Delta Z$  of the base vector and the equatorial components  $\Delta X$  and  $\Delta Y$  are determined with a far lesser accuracy than from  $\tau$  measurements. The purpose of this article is development of a method for determining all three components of the base vector from measurements of the interference frequency  $f$  and the phase difference of a narrow-band signal received at both radiointerferometer stations. The method affords a possibility for using not only quasars, but also other narrow-band sources of powerful radio emission, of which there are several hundred, such as radiogalaxies, remnants of supernovae,  $H_2O$  and  $OH$  masers. The method can be used in regional geodetic networks when the lengths of the bases do not exceed a thousand kilometers. In this case it is necessary to have quite precise values of the coordinates of radio sources, polar coordinates, velocity of the earth's rotation, precession and nutation parameters, all determined independently, as in observations in global VLBI networks. References 7: 3 Russian, 4 Western.  
[236-5303]

UDC 550.312

# RESULTS OF REPEATED GRAVIMETRIC OBSERVATIONS ALONG SAMUR-BAKU PROFILE IN 1978-1982

Baku IZVESTIYA AKADEMII NAUK AZERBAJDZHANSKOY SSR: SERIYA NAUKI O ZEMLE in Russian No 4, 1983 pp 36-39

GADZHIYEV, R.M. and KADIROV, F.A.

[Abstract] Repeated gravimetric observations with four gravimeters were carried out annually during the period 1978-1982 along a profile about 20 km in length along the shore of the Caspian Sea from Samur to Baku. The gravimetric observations were made each 10 km. During the period 1978-1982 the acceleration of gravity along the Caspian shore varied at the rate  $+32 \cdot 10^{-8}$  to  $-35 \cdot 10^{-8}$  m/sec<sup>2</sup> annually. The curve describes a large maximum from Khyrdalan to Samur occupying a length of 180 km. This enormous anomaly can be attributed to the great depth at which the factor generating it is situated. The anomaly-forming factor may be situated somewhere near the Moho (40-50 km) or below it. It seems apparent that the reasons for the variation in the acceleration of gravity with time, like the factors responsible for the rising or subsidence of the earth's surface, can be found in the earth's deep layers at a depth comparable to the depth of the Moho. An observed dropoff of the  $v_g$  curve was possibly attributable to an impending swarm of earthquakes (December 1982-April 1983), the strongest event being an earthquake on 17 December with  $K = 10.5$  at a depth of about 30 km. (It is deemed significant that a similar change in gravity was observed prior to the occurrence of a swarm of earthquakes in Japan in 1965-1967.) Figures 1, tables 2; references: 7 Russian.  
[191-5303]

CLAYEY MINERALS OF SEDIMENTARY COMPLEX IN SECTION OF SUPERDEEP WELL-1  
(SAATLY)

Baku IZVESTIYA AKADEMII NAUK AZERBAJDZHANSKOY SSR: SERIYA NAUKI O ZEMLE in  
Russian No 4, 1983 pp 56-61

SEIDOV, A.G. and KHEIROV, M.B.

[Abstract] In the section of superdeep well-1 (SW-1) at Saatly the deposits of the sedimentary complex with a thickness of 3,522 m are represented by clayey, sandy-silty rocks, clastic and calcareous formations. In SW-1 the clayey rocks constitute the main variety of sedimentary formations in almost all stratigraphic subdivisions in the section. They are best developed in Pliocene and post-Pliocene deposits. There are gray, light gray, greenish-gray and grayish-brown varieties. The content of the pelitic fraction of clays varies in the range 53-75%. Montmorillonite, hydromica, kaolinite and chlorite are found in all the studied clay samples. With respect to their mineralogical composition, these clays are almost identical to the clays of the same age in adjacent areas. On the basis of the quantitative content of predominant clayey minerals the investigated part of the section was divided into three parts (lower, upper and middle), each of which are discussed in detail. Scattered organic matter occurs extensively in the clays of the SW-1 section. The clayey minerals in the clayey rocks are primarily allogenic in origin, whereas those in the sandy-silty rocks are of authigenic origin. With respect to the prospects for finding petroleum and gas it is noteworthy that the SW-1 section includes sandy-silty rocks with high filtration and capacity properties and that the scattered organic matter occurs widely in the clayey rocks of the productive strata, potential petroleum-producing suites. An increase in the thickness of deposits in the productive stratum from SW-1 toward the deposits of the Lower Kura Depression suggests the desirability of conducting exploration work in that direction. Figures 3.

[191-5303]



## POSSIBLE PETROLEUM AND GAS TRAPS IN PRODUCTIVE STRATUM DEPOSITS IN THE LOWER KURA DEPRESSION AND PROSPECTS FOR FURTHER EXPLORATION WORK

Baku IZVESTIYA AKADEMII NAUK AZERBAJDZHANSKOY SSR: SERIYA NAUKI O ZEMLE in Russian No 4, 1983 pp 73-76

SALAYEV, A.L., GASANALIYEVA, T.I., GUSEYNOVA, T.S., MELIKOVA, S.A. and EFENDIYEV, A.A.

[Abstract] The productive stratum (PS) of the Lower Kura Depression has been explored in three stratigraphic intervals (horizons I-VII; horizons VIII-XVII; below horizon XVII). Adequate data have been published on the first interval and therefore the article is limited to the prospects for exploration work in the lower two intervals. The different types of traps which have been detected or which may be found are discussed. The extent of knowledge concerning each of the horizons is reviewed and an assessment is made of the possibilities of encountering petroleum and gas at different depths. This is also done on an area-to-area basis. Specific sites are pin-pointed for concentrated work, especially the drilling of exploratory holes. Structures are designated which warrant priority attention and it is stressed that drilling should be accompanied by geochemical research by the gas survey method. An area has already been prepared for drilling at the juncture of the Lower and Middle Kura Depressions. Still further recommendations on the development of exploratory work can be formulated after this drilling work has been completed. References: 6 Russian.  
[191-5303]

## AREAS OF OCCURRENCE OF MIDDLE PLIOCENE SEDIMENTS

Baku IZVESTIYA AKADEMII NAUK AZERBAJDZHANSKOY SSR: SERIYA NAUKI O ZEMLE in Russian No 4, 1983 pp 77-81

NARIMANOV, A.A. and ALIZOVA, Sh.A.

[Abstract] Middle Pliocene deposits are called the productive stratum (PS) in Azerbaijan and the reddish stratum (RS) in Turkmenia. They have been carefully studied for decades due to their possible content of petroleum and gas. The PS and RS were accumulated in a single closed sedimentation basin and therefore they are lithologically identical. These strata, described in the article in detail, consist primarily of clays, silts and sands in different combinations in different regions. The Apsheron facies of the PS section is of the greatest importance with respect to its petroleum and gas content. Borehole logging has made possible fairly good definition of the Apsheron facies. A schematic map (Fig. 1) shows the limits of the PS and RS. However, borehole logging must be supplemented by a mineralogical comparison of sections separated at considerable distances



from one another. Such work is essential for determining the prospects of finding petroleum and gas in areas which have still been investigated relatively poorly. The mineralogical composition of the RS in certain places is very similar to the upper part of the PS in the Apsheron region but the limited amount of borehole logging data for the reddish deposits precludes a thorough comparison of the RS with the lower part of the PS. On the basis of these and other data it has been possible to define the most promising areas for reconnaissance work for petroleum and gas in the regions occupied by the PS and RS. Specific types of work are recommended for specific areas. Figures 1; references: 9 Russian.  
[191-5303]

UDC 550.348.098.64

#### SEISMICITY IN AZERBAIJAN IN 1980 AND 1981

Baku IZVESTIYA AKADEMII NAUK AZERBAJDZHANSKOY SSR: SERIYA NAUKI O ZEMLE in Russian No 4, 1983 pp 82-88

KASPAROV, V.A., KULIYEV, F.T., AGALAROVA, E.B., GASANOV, A.G., GYUL', E.K., IGNAT'YEVA, O.A. and SHAFADIYAYEV, R.N.

[Abstract] During 1980-1981 seismological observations in Azerbaijan were made at 14 stations. Parameters of the epicentral fields were determined using these data, supplemented by data from Georgia and Armenia. During these two years there were 181 and 171 earthquakes respectively with  $K \geq 9$ , some of which were foreshocks and aftershocks of stronger earthquakes. The distribution of epicenters of earthquakes of different classes was mapped (Figures 1 and 2). A table gives the time and coordinates of earthquakes, their magnitude  $M$ , energy class  $K$ , epicentral intensity  $J_0$  and focal depth  $h$ . The most important event during this period was the Ismailinskoye earthquake of 29 November 1981, followed by a series of strong aftershocks on 2, 4 and 7 December. On the maps of seismic activity in Azerbaijan compiled for periods of 20 and 40 years all the seismically active zones of 1980 and 1981 were associated with zones of high mean long-term activity  $A_{10} \geq 0.2$ . It is recommended that for predicting sectors which will be seismically dangerous in the near future a comparative quantitative analysis should be made of the current and mean long-term seismic activity of different seismotectonic blocks, as well as the dynamic parameters of development of activity within them. Figures 4, tables 2; references: 7 Russian.  
[191-5303]

## KINEMATICS OF CARPATHIAN STRUCTURAL LOOP

Moscow GEOTEKTONIKA in Russian No 3, May-Jun 84 (manuscript received 21 Mar 83) pp 17-31

BURTMAN, V.S., Geological Institute, USSR Academy of Sciences

[Abstract] The Carpathian structural loop is outlined by the folded system of the Western, Eastern and Southern Carpathians. The extent of this structural loop from the Alps to the Balkans is more than 1,500 km. Paleomagnetic studies made in recent years have made it possible to clarify the origin of this structural loop. On the basis of these new data a study was made of the kinematics of the Carpathian loop using data on tectonic and biogeographic zonality, paleomagnetic research and analysis of the form of the Alpine folded zone in the segment from the Eastern Alps to Asia Minor. The area to be studied was first divided into a number of megazones, the common criterion being the age of flysch deposits. The Jurassic facies is used as an additional criterion. Eight megazones were defined and each is briefly described. This zonality can be used in an analysis of post-Cretaceous deformations. A biogeographic zonality was also worked out. Three possible variants of formation of the structural loop are examined. It is concluded that the loop developed as a result of general deformation in the zone. This deformation was caused by rotation of its Asia Minor-Balkan part relative to the more northerly part of the zone (in a counterclockwise direction by 30-40°). The Carpathian-Pontic and Dinaric-Taurus branch of the Alpine zone experienced a dysharmonic plastic deformation, this giving rise to the loop, an event occurring in the Paleogene-Early Miocene. Figures 6, tables 3; references 49: 7 Russian, 42 Western. [215-5303]

UDC 551.242.3+552.323.5(571.651)

## STRUCTURAL POSITION AND PETROCHEMISTRY OF DANIAN-PALEOCENE BASALTOIDS OF LA'KATVAAM ZONE OF KORYAK RANGE

Moscow GEOTEKTONIKA in Russian No 3, May-Jun 84 (manuscript received 20 May 82) pp 88-89

GRIGOR'YEV, V.N., KAZIMIROV, A.D., KRYLOV, K.A. and SOKOLOV, S.D., Geological Institute, USSR Academy of Sciences

[Abstract] Within the limits of the Koryak-Kamchatka segment of the northwestern margin of the Pacific Ocean there are a number of basaltoid complexes which are associated with different structural-formation zones differing in their internal structure and history of development. Their age is not entirely identical and the petrochemical types of Cretaceous-Paleogene basaltoids vary. Detailed work done in recent years has now made

it possible to interpret the principal features of the Koryak Range. Specifically, sections of the Kakanaut complex of Danian-Paleocene age were investigated in this area from the headwaters of the Vaamochka River in the southwest to the headwaters of the Vel'kel'veyem River in the northeast. A three-membered structure is characteristic for most of the sections. Volcanomictic, terrigenous, tuff-hyaloclastic and lava strata can be discriminated from bottom to top. The volcanic component of the Kakanaut complex is poorly differentiated with a tendency to continuous differentiation from picrite basalts to andesites with a mode on the distribution histograms in the basalt region. A total of 40% of the effusives are rocks of the tholeiitic series and 60% are rocks of the alkaline series. The authors present a petrochemical comparison of Kakanaut volcanic rocks and volcanic rocks of different zones of the present-day ocean. The appearance of Kakanaut volcanism is related to the period between the pre-Maestrichtian, forming the covering structure of the Ekonay zone and the post-Paleocene, forming the structure of the Koryak Range as a whole and especially the covering structure of the Al'katvaam zone. It is assumed that the Danian-Paleocene volcanism of the Koryak Range is situated at the edge of the newly formed Bering Sea paleoshelf. Figures 8, tables 2; references: 16 Russian.

[215-5303]

UDC 551.243.23(491.1)

#### STRUCTURE OF ICELAND AND OCEAN FLOOR SPREADING

Moscow GEOTEKTONIKA in Russian No 3, May-Jun 84 (manuscript received 28 Dec 81) pp 100-111

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[Abstract] The conclusion that the earth's crust of Iceland was formed as a result of spreading is consistent with a number of facts: the western zone of most recent volcanism in Iceland is precisely on the strike of the submarine Reykjanes Ridge, regarded as the axial rift of the Mid-Atlantic Ridge and accordingly as the spreading axis; the age of Icelandic rocks emerging at the surface increases from its central part to its western and eastern margins; the radiological age of the rocks emerging at the surface on the continuation of one of the clearly expressed linear magnetic anomalies in the ocean coincides closely with other earlier estimates on the age of this anomaly. However, new data on the tectonics of Iceland have been obtained which made it possible to compile a map of the strikes of the plateau basalt stratum and a diagram of dislocations. On the basis of an analysis of the structural data summarized in this article the conclusion is drawn that the plicated structure began to form at the time of accumulation of the plateau basalt stratum as a result of nonuniformly distributed vertical movements. It is demonstrated that the development of neovolcanic zones (regarded as rifts) is attributable to the association of recent volcanism with a system of rejuvenating faults constituting part of

an earlier forming unified network of dislocations occupying the entire island. The analysis of the network of dislocations and other data presented in the article indicates that the postulated latitudinal zones of transformed faults in the Iceland area in actuality do not exist and therefore the present-day disjunctive and plicated structure of the island cannot be tied in with the spreading hypothesis. Figures 6; references 10: 4 Russian, 6 Western.  
[215-5303]

UDC 551.242.31(479.24)

#### TECTONIC NATURE OF KURA DEPRESSION

Moscow GEOTEKTONIKA in Russian No 3, May-Jun 84 (manuscript received 7 Sep 81) pp 118-121

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[Abstract] The top of the Mesozoic deposits in the Kura Depression has been penetrated by dozens of deep boreholes, some of which have penetrated the entire section of the Lower Cretaceous and have even entered rocks of Upper Jurassic age. Pertinent, revealing data from superdeep holes -- Saatly (below 5,100 m), Dzharly (depth 4,820 m) and Muradkhanly (5,250-5,300 m) are dated on the basis of absolute geochronology as rocks of the Upper Jurassic. New and important information has thus been obtained for judging the conditions for tectonic development of the depression in the pre-Paleogene stage of its history. Joint processing of the latest deep drilling and seismic prospecting data for the Kura Depression now make it possible to draw sounder judgments concerning the Mesozoic. The problem has also been studied on the basis of regional seismic work carried out in the depression, for the most part during the last decade, as well as gravitational data with the use of correlations between the observed gravity field in the Bouguer reduction and the depth of the corresponding discontinuities in the crust. In addition, data were available from a series of magnetotelluric soundings. On the basis of all these materials for the first time for this region it was possible to prepare an integrated map of the distribution of thicknesses of the Mesozoic complex and on that basis to make a geotectonic analysis. It now seems clear that the area has a geosynclinal nature, not being a median mass, as assumed earlier. One of the criteria indicating that the Kura depression is a geosynclinal structure is the exceedingly high mobility of the earth's crust in it. This was expressed primarily in an active sinking of the crust not only in the Cenozoic, but also during a considerable part of the Mesozoic. There is basis for assuming that the Kura Depression is an integral part of the alpine folded zone of the southern USSR.  
Figures 2; references: 20 Russian.  
[215-5303]



## REVIEW OF PROBLEMS IN LITHOLOGY

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 9, Sep 84 pp 69-77

TIMOFEYEV, P.P., corresponding member, USSR Academy of Sciences

[Abstract] The fundamental problems in modern lithology and its role in the development of geological science are reviewed; the further development of the mineral raw material base of the country dictates that significant work be done for advancing this field. The different aspects of lithology are examined, with discussion of the contributions made to the development of lithology by different researchers and the work which has been and is being done along these lines by different research and field organizations. It is emphasized that even the geological community has underappreciated the importance of work in the field of lithology. Much attention is given to the relationship between lithology and the formation and patterns of distribution of mineral deposits. It is essential that lithologists contribute more fully to solution of problems related to the localization of ore bodies and the process of formation of sedimentary layers and their changes in the course of geological history with the formation of mineral deposits. The further development of lithology cannot be restricted to the isolated study of individual objects, regions, continental blocks or sediments of the oceans and seas. Research is required which would involve a comparative analysis of the global processes transpiring in the past and occurring in the present epoch on the continental blocks and in deposits of present-day oceans and seas. This could serve as a basis for clarifying the evolution of the sedimentation process and sedimentation basins in the earth's history. The subjects for research in the future include: specific features of sedimentation basins in different periods of the earth's development, correlation of sedimentation basins of different structural-tectonic and climatic zones, general scheme of evolution of basins in the history of the planet, global correlation of types of lithogenetic transformations in different tectonic and climatic regions, global correlation of geological formations in time and space, role of exogenous and endogenous factors in formation of epochs of sedimentary ore formation, and global correlation of geological processes in different regions of the earth. A scientifically validated macroscale geological survey, it is stressed, is unthinkable without a detailed complex lithological-facies and formation investigation of sedimentary deposits. There is an urgent need for the training of professional lithologists. The only such training facilities are at Leningrad and Tashkent Universities, together with a new department of lithology at Moscow University established in December 1983. Indeed, there is no curriculum for the training of lithologists.

Figures 4.

[84-5303]



## MAGMATISM IN CONTINENT-OCEAN TRANSITION ZONE (DEVELOPMENT OF IDEAS OF A.N. ZAVARITSKIY)

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA GEOLOGICHESKAYA in Russian No 6, Jun 84 (manuscript received 29 Feb 84) pp 8-27

BOGATIKOV, O.A., KOVALENKO, V.I., RYABCHIKOV, I.D. and TSVETKOV, A.A.,  
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[Abstract] An article in which A.N. Zavaritskiy first demonstrated the presence of seismic focal zones in nature and predicted their possible tectonic role was published in 1946. (The classical article by H. Benioff on this same subject was not published until four years later.) Zavaritskiy correctly postulated that recent tectonic movements must be studied in zones of concentration of volcanoes and deep-focus earthquakes. He related the grandiose tectonic and magmatic phenomena along the periphery of the Pacific Ocean to movement in a seismic focal zone. In developing the ideas of A.N. Zavaritskiy, in this article the authors limit themselves to the general characteristics of Zavaritskiy-Benioff zones at the modern level of knowledge from the point of view of magmatic petrology, evolution of island arc magmatism and the problem of genesis of andesites typomorphic for the magmatism of island arcs and the related problems of growth of the continents. The text is in large part centered around the figures and tables. Fig. 1 -- Projection of earthquake foci onto plane perpendicular to direction of Kuril Islands; Fig. 2 -- Diagram of structure of Zavaritskiy-Benioff zone in island arc region; Fig. 3 -- Reconstruction of plunging of Zavaritskiy-Benioff zone beneath Tonga-Kermadec island arc; Fig. 4 -- Diagram of correlation of magmatism of island arcs of different degrees of maturity; Fig. 5 --  $^{87}\text{Nd} - ^{87}\text{Sr}$  diagram for magmatic rocks of different types of island arcs (young, well developed, mature); Fig. 6 -- Projections of phase volumes of main rock-forming minerals onto plane; Table 1 -- Principal chemical characteristics of magmatic series of island arcs; Table 2 -- Diagram of magmatic evolution of island arcs. The fundamental ideas of A.N. Zavaritskiy later led to the discovery of zones of magma formation in the world system of mid-oceanic ridges and at hot points and the magmatism of the destructive boundaries of lithospheric plates, which later became the cornerstone of plate tectonics. Figures 6, tables 2; references 56: 22 Russian, 34 Western.

[248-5303]

## TEMPERATURE PREDICTIONS AT GREAT DEPTHS IN CENTRAL AND NORTHEASTERN CAUCASUS

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA GEOLOGICHESKAYA in Russian No 6, Jun 84 (manuscript received 23 Sep 82) pp 116-125

SUKHAREV, G.M., VLASOVA, S.P. and ZUBKOVA, S.P., Groznyy Petroleum Institute

[Abstract] The sounder planning of reconnaissance work for petroleum, gas condensate and gas requires the availability of predicted temperatures at different depths in rocks of different age in the Caucasus. The authors exploited all available materials in order to define the principal regularities in distribution of the temperature field in deep-lying Mesozoic-Cenozoic deposits in the central and northeastern Caucasus. Data on deep heat flows are used in formulating a method for predicting deep temperatures, as are experimental data on the influence of temperature and pressure on the thermal conductivity of rocks. A series of figures was prepared on the basis of research data and the formulated prediction method: 1 -- temperature change with depth in Caucasus region; 2 -- predicted temperatures at depth of 3,000 m; 3 -- at 5,000 m; 4 -- at 7,000 m; 5 -- at 9,000 m; 6 -- at 12,000 m. Such calculations provide guidance in organizing the direction of exploration work for petroleum, gas and gas condensate and in ascertaining the number and depths of holes needed for studying promising depths. These data indicate horizons at which the finding of petroleum is unlikely and where petroleum should be replaced by gas condensate or gas. It seems clear, for example, that at a depth of 6,000 m petroleum may be highly improbable. Predicted temperatures in Paleozoic deposits revealed the impossibility of conservation of fluids and gases in these deposits. Favorable conditions exist in many areas for the use of geothermal heat for economic purposes; this is particularly true in the neighborhood of extinct volcanoes in Armenia, Azerbaijan and Georgia. Figures 6, tables 2; references: 11 Russian. [248-5303]

UDC 550.848:551.462

## POSSIBILITY OF MAPPING ACTIVE TECTONIC STRUCTURES FROM MERCURY GAS AUREOLES OVER SEA SURFACE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 275, No. 5, Apr 84 (manuscript received 3 May 83) pp 1162-1164

GANEYEV, A.A., MASH'YANOV, N.R., SVESHNIKOV, G.B. and SHOLUPOV, S.Ye.

[Abstract] Direct measurements of Hg content in the atmosphere were made in the Bering Sea area and the northwestern Pacific Ocean along the shores of Chukotka and Kamchatka. The shipboard observations were made with a

Zeeman selective atomic absorption spectrometer. This instrument registered the concentration of atmospheric Hg in the air layer between the radiation source and receiver on a path 1 m long. Instrument response was  $4 \cdot 10^{-8}$  g/m<sup>3</sup> with a time constant of 5 sec. The profile intersected the shelf, continental slope, regions of abyssal depressions, rises and ridges in the northern part of the Kuril-Kamchatka island arc. In a number of regions there were increased concentrations of Hg vapor over the sea surface exceeding the atmospheric clark of concentration by a factor of 2-3. The greatest number of anomalous zones was in regions of shallow depths 200-1,000 m; a few such cases were observed over abyssal parts of the Pacific Ocean where the depths were greater than 4,000 m. The strongest Hg anomalies over the sea surface were situated on the continental shelf in regions of active tectonic zones associated with deep faults extending into the continental parts of Chukotka and Kamchatka. These faults control the position of some Hg ore-bearing zones. Increased Hg values were also observed over sectors containing increased Hg contents in the products of modern volcanic and geothermal activity on Kamchatka. It is postulated that vaporous Hg is transported upward through the ocean in the form of gas bubbles. Figures 2; references 9: 4 Russian, 5 Western.  
[244-5303]

UDC 550.36

#### NORMAL AND ANOMALOUS GEOTHERMAL FIELDS AND THEIR RELATIONSHIP TO HIERARCHY OF GEOLOGICAL BODIES

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 275, No. 5, Apr 84  
(manuscript received 6 Jul 83) pp 1084-1087

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[Abstract] The principle of a hierarchy of geological bodies and specifically the "rank approach" is used in clarifying the problem of the geothermal background (or "normal" geothermal field). It is proposed that the concept of a local background be introduced as the heat flow characterizing the geothermal regime of an "object" of a higher order (rank, class, scale) than the studied object. For example, for an arch the local geothermal background is the heat flow determining the regime of a syncline, for a syncline -- the flow determining a platform regime. The problem of finding the local background involves the breakdown of the really determined distribution of heat flow values into "elementary" distributions; the distribution with the maximum weight must be assumed normal. The background heat flow is the mathematical expectation of an "elementary" normal distribution with a maximum weight. Specific cases are examined in which all the "elementary" distributions are assumed to be normal. All the distribution parameters were computed by the least squares method. The method was used in analyzing the geothermal fields of several arches, such as the Astrakhan arch, where electrical sounding data make it

possible to relate the source of the geothermal anomaly to an object associated with subsalt deposits at a depth greater than 4 km. A histogram shows the geothermal flow in the arch and the discriminated "elementary" distributions. Figures 3, tables 3; references: 8 Russian. [244-5303]

UDC 550.34

# FURTHER STUDY OF DEPENDENCE OF EARTHQUAKE FOCUS VOLUME ON EARTHQUAKE ENERGY

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 275, No. 5, Apr 84  
(manuscript received 5 Dec 83) pp 1087-1088

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[Abstract] In an earlier article (M.A. Sadovskiy, et al., DAN, Vol 272, No 3, 1983), it was demonstrated that the dependence of the volume of a seismic focus  $\omega$  on earthquake energy  $\epsilon$  can be expressed approximately as

$$\lg \epsilon = \lg \omega + 3 \text{ or } \epsilon = 103 \cdot \omega \text{ erg/cm}^3.$$

This dependence was derived for earthquakes with magnitudes from 6 to 8.5 occurring throughout the earth. Data published by D.I. Sikharulidze, et al. in STROYENIYE, NAPRYAZHENNOYE SOSTOYANIYE I USLOVIYA SEYSMICHNOSTI LITOSFERY MALOGO KAVKAZA (Tbilisi, 1983) have made it possible to extend the region of applicability of this dependence to earthquakes with a magnitude from 4 to 6. The results of such work are given in a table: for different intervals of magnitudes  $M$ , the corresponding mean values  $\lg \epsilon$  and  $\lg \omega$  and their differences  $\Delta$ , as well as  $n$ , the number of observations for each interval. A figure shows the experimentally determined dependence of  $\lg \epsilon$  on  $\lg \omega$  in comparison with the formula recommended earlier:  $\lg \epsilon = \lg \omega + 3$ . It now seems possible to further broaden the range of magnitudes in the direction of their decrease. This would involve difficulties in determining the extent of seismic foci, but it is possible that data from the Nurek and Garm seismic test areas with their dense network of stations might make it possible to attain the necessary accuracy in determining the position of epicenters of weak earthquakes with  $M < 4$ . Figures 1, tables 1; references: 2 Russian. [244-5303]



## STUDY OF CONTEMPORARY GEODYNAMIC PROCESSES

Leningrad IZVESTIYA VSESOYUZNOGO GEOGRAFICHESKOGO OBSHCHESTVA in Russian  
Vol 116, No 4, Jul-Aug 84 (manuscript received 20 Oct 83) pp 379-381

SELIVERSTOV, Yu.P.

[Abstract] The first field geomorphological school was held 15 through 25 September 1983 in the mountains of southern Turkmenia. Organized jointly by the Geography Institute, USSR Academy of Sciences, and the Seismology Institute, Turkmen Academy of Sciences, the school was intended to improve the qualifications of specialists in studying contemporary relief-forming processes in geodynamic areas, the basis being the Ashkhabad geodynamic field range. The program included: a) familiarization with methods of isolation and field mapping of areas of active manifestation on contemporary and ancient seismic dislocations expressed in the relief and recent deposits as well as other similar phenomena on the surface; b) familiarization with methods of field instrumental observations of the development of processes; c) field morphostructural and particularly morpho-sculptural studies in various regions; d) demonstration of relicts in the relief of various ages in the history of development of the surface of the region and prediction of possible changes in the immediate future.

[45-6508]

UDC 550.837

## VARIATIONS IN RESISTIVITY OF UPPER CRUSTAL LAYER

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 278, No. 2, Sep 84  
(manuscript received 26 Jan 84) pp 330-334

SIDORIN, A.Ya., Earth Physics Institute imeni O.Yu. Shmidt, USSR Academy of Sciences, Moscow

[Abstract] A stationary system of year-round observations of changes in resistivity of the upper layer of the earth's crust was organized in the Garm Test Area. Year-round observations of variation in temperature at various depths were also made, allowing in situ determination of the temperature conductivity coefficient under the specific conditions of the test range. Equations are presented which can be used to estimate the changes in apparent resistivity. The equations indicate that the thicknesses of the diurnal and annual temperature change skin layers are 0.1 and 2.1 m. Variations in resistivity and temperature at a depth of 3.1 m are diagrammed. The results showed that the estimates of annual changes in apparent resistivity based on temperature changes alone are insufficient. Reliable estimates require a cycle of observations of variations of surface layer resistivity at various points. Figures 3; references 5: 4 Russian, 1 Western.

[113-6508]

## URANIUM AND ACCOMPANYING ELEMENTS IN PROCESS OF FORMATION OF URANIUM-BEARING ALBITITES

Kiev GEOLOGICHESKIY ZHURNAL in Russian Vol 24, No 5, Sep-Oct 84 (manuscript received 21 Mar 83) pp 39-43

ZINCHENKO, V.A. and KACHINSKIY, A.B., Institute of Geochemistry and Physics of Minerals, Ukrainian Academy of Sciences, Kiev

[Abstract] Uranium deposits associated with sodium metasomatism processes are formed in albitites developed from granitoid and gneiss rocks of crystalline shields and tend to be associated with zones of regional faults. A theoretical study was made in which the geochemical aspects of uranium ore formation in sodium metasomatites are examined on the basis of the fundamental and thermodynamic properties directly related to the structure of atomic electron shells and thermodynamic computations. The paragenesis of chemical elements in the uranium ore-forming process and their association in forming uranium mineralization in albitites was investigated using data on ionization potentials, electron affinity and affinity to oxygen, fluorine, sulfur and chlorine. A comparison was made of theoretical data on the elements accompanying uranium and corresponding data obtained by analytical procedures and it was concluded that the theoretically postulated entry of a series of chemical elements into uranium ore albitites coincides with actual observations. The theoretical concepts on the paragenesis of chemical elements in the formation of uranium-bearing sodium metasomatites indicate that for studying the accompanying elements in samples it is most important to determine the content of thorium, yttrium, erbium, vanadium, titanium, zirconium, scandium, dysprosium, gadolinium, neodymium, samarium, barium, cerium, niobium, indium, thallium and lithium. In solving problems in the geochemistry of uranium in connection with the formation of alkaline metasomatites the study of matter for determining a number of chemical elements must be carried out at a higher threshold of response of analytical methods than is possible by usual spectral analysis, particularly with respect to lanthanoids. Figures 1; references:

14 Russian.

[94-5303]

## SERPENTINITE MELANGE AND ULTRABASITE OF NORTHERN VALAGINSKIY RANGE (EASTERN KAMCHATKA)

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 278, No. 1, Sep 84  
(manuscript received 17 Feb 84) pp 180-184

RAZNITSIN, Yu.N., TSUKANOV, N.V. and SHCHERRBAKOV, S.A., Geology Institute, USSR Academy of Sciences, Moscow

[Abstract] The northern part of the Valaginskiy Range in eastern Kamchatka contains numerous primordial rocks of volcanic and silicon origin. The present article reports on studies made in 1982 that suggest a new explanation of the region's geological structure and a new perception of the nature of ultrabasite. Weak tectonic strata of basalt and andesite-basalt and agglomerate deposits form a polymictic serpentinite melange covering some 20 square kilometers. Various deposits of these rock types are described as found on specific mountains of the eastern Kamchatka region. The deposits have a southeasterly orientation, toward the Pacific Ocean, indicating movement from that direction, for which however insufficient information is available. Periods of geological origins for silicon and volcanic deposits are suggested. The ultrabasite is considered to be a dunite-harzburgite complex of an ophiolitic association, with two stages of plastic deformation in the ocean mantle. Figure 1; references 8:

6 Russian, 2 Western.

[81-12131]

UDC 550.311

## BOUNDARY VELOCITIES OF LONGITUDINAL SEISMIC WAVES AND LATERAL INHOMOGENEITIES OF UPPER OCEAN MANTLE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 278, No. 1, Sep 84  
(manuscript received 28 Dec 83) pp 76-81

KUNIN, N.Ya., GONCHAROVA, N.V., SEMENOVA, G.I., USENKO, S.V., SHEYKHZADE, E.R. and ZORINA, Yu.G., Earth Physics Institute named O.Yu. Schmidt, USSR Academy of Sciences, Moscow

[Abstract] Seismic shock-wave study of the earth's crust and the ocean upper mantles has accelerated during recent decades, but receives little publicity, partly due to the lack of integrated presentation of the data collected. This article offers such a synthesis of data on boundary velocities of longitudinal refracted waves along the surface of the upper ocean mantle (the Mohorovicic discontinuity), expressed by the notation  $V_{gm}$ . Studies were made in the Pacific, Atlantic and Indian Oceans over widely diverse regions. Typical studies of this sort have used travel-time curves of 40-50 km in length; first arrivals approximating a straight line exceed 5-10 km on such travel-time curves. Soundings and profile

observations indicated that relatively small vertical velocity gradients were found for as much as 100-300 km. The velocities can be regarded as largely homogeneous. Results show that much of the North Atlantic and most of the Indian Ocean, as well as the Mediterranean Sea and European parts of the Atlantic to the latitude of Gorky-Odessa in the USSR, Arabia, Greenland and much of Africa share an enormous homogeneous region with only normal and suppressed  $V_g^m$  readings. The Pacific is characterized by the Eastern ridge, northern zone and Australian region. High values for  $V_g^m$  prevail in the Pacific, southern Indian and Atlantic Ocean zones. Oceanic and continental regions showed great similarities. Figures 2; references 14: 10 Russian, 4 Western.  
[81-12131]

UDC 550.837.2

#### DISCRIMINATION OF NORMAL AND ANOMALOUS MAGNETIC AND ELECTRIC FIELDS IN GEOELECTROMAGNETIC VARIATIONS

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 7, Jul 84 (manuscript received 5 Nov 82) pp 121-126

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[Abstract] Algorithms are presented for discriminating magnetic and electric fields observed in the world network and subject to spherical analysis by algorithms developed in a previous work into normal and anomalous parts. The algorithms feature the ability, based on the results of spherical analysis, to break the field down into electric and magnetic fields, distinguishing external and internal origin fields in both types, retrieving all 6 electromagnetic components of the field based on measured magnetic components. Unambiguous discrimination of normal and anomalous fields, separation of the fields of deep anomalies from fields of surface anomalies in magnetic and electric fields, requires measurement of three magnetic components of the variation field and assignment of two conductivities.  
References: 6 Russian.  
[39-6508]



## REFLECTED WAVE TRAVEL-TIME CURVES IN STRATIFIED MEDIA WITH VERTICALLY HETEROGENEOUS LAYERS AND SLIGHTLY SLOPING CURVED BOUNDARIES

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 7, Jul 84 (manuscript received 25 Feb 83) pp 107-114

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[Abstract] Numerical methods of determining travel-time curves do not allow sufficient study of the influence of various heterogeneities on kinematic parameters of reflected waves. In many cases, models of actual media differ little from the model of a horizontally stratified medium with vertically heterogeneous layers. A previous work has studied the problem of transfer of slight deviations in boundaries from the horizontal to changes in time fields. This article gives approximate equations for the coefficients of an expansion used in the previous work for a medium with near-horizontal boundaries and vertically heterogeneous strata. The formulas allow explicit analysis of the influence of curving of boundaries on the coefficients of the expansion and therefore on the limiting parameters of the reflected wave travel-time curve. The method, while not very sensitive to slight slopes, reacts strongly to the presence of curved refracting boundaries in the upper portion of the cross section.

Figures 2, references: 8 Russian.

[39-6508]

UDC 553.068:553.495

## CONDITIONS FOR ACCUMULATION OF URANIUM AND THORIUM IN BASAL LAYERS OF SEDIMENTARY COVER OF LARGE PLATFORM DEPRESSIONS

Kiev GEOLOGICHESKIY ZHURNAL in Russian Vol 44, No 4, Jul-Aug 84 (manuscript received 15 Jul 83) pp 46-58

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[Abstract] A study is made of large depressions located on the opposite sides of a regional platform-type upthrust, within which the crystalline basement reaches the surface. It is characteristic of the basal deposits of both depressions that elevated concentrations of U and Th are present over large areas, sometimes forming stratal ore bodies. A comparative study of radioactive mineralization is used to determine conditions for accumulation of U and Th in the basal layers of the sedimentary cover and to reveal the significance of epigenetic processes in the formation of ores. Their accumulation occurred in the early stages of lithogenesis, the early concentrations of U and Th being by sorption, the elements concentrated to a lesser extent in fragmentary accessory minerals. Under humid climate conditions the major U and Th concentrator is kaolinite, under arid conditions, hydromica, montmorillonite, Fe and Mn hydroxides. The basal

layers of the sedimentary cover inherit the geochemical specifics of the crystalline basement rock. For most elements there is a decrease in mean content in littoral-marine deposits and the upper basal deposits of the Devonian and Cretaceous in comparison with continental deposits. In the stage of katagenesis and in metagenesis as a result of transformation of clay or hydromica cement, redeposition of U occurred with formation of its oxides. Additional enrichment of uranium-thorium mineralization occurred in the Eiffel stage as a result of reducing epigenesis accompanied by breakdown of uranium-thorium-containing oxides of Fe and redeposition of the element. Figures 3, tables 1; references: 5 Russian. [33-6508]

UDC 581.19:547.963.32

POSSIBILITY OF REVEALING VERTICAL CONDUCTING ZONES IN MUGODZHAR REGION IN MAGNETOTELLURIC AND MAGNETIC VARIATION STUDIES

Alma-Ata VESTNIK AKADEMII NAUK KAZAKHSKOY SSR in Russian No 9, Sep 84 pp 56-60

KARIMOV. K.M., candidate of geological-mineralogical sciences

[Abstract] Information on the geological structure of Mugodzhah was used to determine certain general specifics of deep fractures. Parameters of the normal geoelectric cross section are presented. Calculations were made for geoelectrical cross sections with sediment thickness of 10 to 500 m and  $\rho_1 = 10 \text{ ohm}\cdot\text{m}$  in order to estimate the influence of the zone overlying a fault on the magnetotelluric field. The influence of the slope angle and depth of the base of the conducting zone on the MT and MV field was studied. It was found that the width of the fault zone is approximately equal to the width of the anomalous area on profiles of impedance curves in H polarization. However, the projection of the fault zone onto the horizontal axis is determined by the distance between maxima on the Wise vector modulus. This requires that detailed magnetic variation profiling be performed in the direction perpendicular to the axis of the structure. The distance between observation points along the profile can be selected so that the object being traced is clearly shown on the curve at no less than 8 or 9 points. Figures 3; references: 3 Russian. [112-6508]

UDC 550.334

STUDY OF GEOLOGICAL MEDIA BASED ON SCATTERED EARTHQUAKE WAVES

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 278, No. 3, Sep 84  
(manuscript received 24 Feb 84) pp 575-580

BOVENKO, V.G., and SHCHERBAKOVA, B.Ye.

[Abstract] The use of new classes of models of media to provide a foundation for the observed specifics of the wave field in the exchange wave method has allowed the physical properties of the method to be reanalyzed, yielding an explanation for experimental variations and producing simple methods of solution of the inverse problem. Solutions obtained by adopting a model of the geological medium as random and ordered-heterogeneous have been most fruitful. The localization of scattering heterogeneities is performed by the method of rays in the form of dynamic cross sections. The physical basis of the method of investigation of geological media based on longitudinal and scattered exchange waves from earthquakes has been derived by physical and mathematical modeling of these wave processes. Results are presented from a study of the process of scattering of ultrasonic pulse waves in a medium including a local heterogeneity of circular shape with a transverse dimension approximately 1-1/2 times the longitudinal wavelength, located at a depth of about 5 longitudinal wavelengths. The source of oscillations was located beneath the center of the heterogeneity by about an additional 5 wavelengths. The most interesting result of the model experiment was detection among the scattered exchange waves of PS and SP waves with an intensity of the same order of magnitude as that of the transmitted P and S waves. This result is confirmed by mathematical modeling of the scattering of harmonic oscillations. The most interesting geological result of application of the method is localization of sub-vertical zones of heterogeneities identified with faults: determination of their position, slope angle and possible penetration depth. Analysis of the more detailed structure of the anomalous phase cross section allows tracing of certain anomalies over lateral lines, with separation of individual seismic layers in the cross section. Figures 3; references: 6 Russian.

[119-6508]

UDC 550.8:62.001.7

SCIENTIFIC-TECHNICAL PROGRESS IN GEOLOGICAL PROSPECTING WORK

Moscow RAZVEDKA I OKHRANA NEDR in Russian No 7, Jul 84 pp 39-43

ROGOV, V.F., GOLIKOV, S.I. and TARASOV, V.N., USSR Ministry of Geology

[Abstract] Geophysical work is among the most important of geological studies. Studies have now been extended down to 5,500 m depth without structural drilling. The search for and mapping of nonanticlinal traps, prediction of geological cross sections and location of deposit type objects are among recent achievements. A program of combined study of the deep structure of the continental crust is being implemented by drilling of deep and superdeep boreholes primarily in oil and gas well and mining regions of the nation. Soviet geologists are performing important work in the area of studying the mineral resources of the world ocean. Large scientific research vessels with modern geophysical, navigation and geological prospecting apparatus are in use. Each year some 14,000,000 samples are taken of mineral raw materials and analyzed. The BSK-2RP drill for drilling geological prospecting boreholes from underground workings is illustrated. The large-scale practical introduction of the achievements of scientific and technical progress requires improvement in the economic mechanism in geology. This approach will help to ensure the full potential economic benefit to the nation which could be provided by this area of human achievement.

[37-6508]

UDC 551.14:550.822.6(24:181)

STUDY OF DEEP CRUSTAL STRUCTURE -- STATUS AND PROSPECTS

Moscow RAZVEDKA I OKHRANA NEDR in Russian No 7, Jul 84 pp 12-18

KOZLOVSKIY, Ye.A.

[Abstract] Three stages are distinguished in the history of studies of the deep structure of the crust in the USSR. The Kola superdeep borehole (SG-3) reached a depth of 12,000 meters by the end of 1983. Broad complex core studies and studies of the surroundings of the borehole, including geologic, petrographic, geochemical, mineralogical, structural, radiological, seismoacoustical, nuclear physical, magnetic, electrical and thermal studies have been undertaken in this hole. The most important results in the areas of geology and geophysics are briefly summarized.

[37-6508]



## ACHIEVEMENTS AND PROBLEMS OF PROSPECTING GEOPHYSICS IN THE USSR

Moscow RAZVEDKA I OKHRANA NEDR in Russian No 7, Jul 84 pp 43-48

ZAYCHENKO, V.Yu., USSR Ministry of Geology, KARUS, Ye.V., 'Neftegeofizika' Scientific-Production Association, and ZHOGOLEV, L.P., 'Rudgeofizika' Scientific-Production Association

[Abstract] Soviet scientists have created high-precision gravimeters and highly sensitive magnetometers for the solution of geological prospecting problems. New seismic research methods are supported by various modifications of multichannel digital stations, successfully used in oil and gas exploration as well as in other geological exploration work. The introduction of various technical and methodological achievements in geophysics has created prerequisites for solution of important geological prospecting problems such as determination and mapping of structures promising for further prospecting, particularly reef bodies; tracing of zones of lithological substitution of rock; detection of low-contrast bodies; spatial tracing of individual deposits; prediction of parameters of the geological cross section; and detection of mineral and oil deposits directly under favorable conditions. During the present five-year plan, institutes and associations are working on the development of geophysical apparatus and equipment to be used in the search for and study of deep deposits of oil, gas and other useful minerals. Multichanneled telemetry systems are being designed for the collection, recording and processing of multicomponent parameters of geophysical fields. Marine geological-geophysical work is being rushed forward in the USSR to support the search for deposits of oil, gas and other useful minerals in the seas and deep-water regions of the world ocean. More than seventy computer centers are at work, equipped with modern computers, superpowerful electronic computer systems based on high-speed multiprocessor machines produced in the Soviet Union such as the PS-2000, PS-3000 and others, which can handle modern methods of combined interpretation of geological and geophysical data.

[37-6508]

UDC 553.41(574)

## DURATION, INHERITANCE AND EVOLUTION OF ENDOGENOUS MINERAL FORMATIONS IN KAZAKHSTAN GOLD ORE FIELDS

Alma-Ata IZVESTIYA AKADEMII NAUK KAZAKHSKOY SSR in Russian No 4, Jul-Aug 84 pp 1-12

KUDAYBERGENOVA, N.K. and PRONIN, A.P., Geological Sciences Institute imeni K.I. Satpayev, Kazakh Academy of Sciences, Alma-Ata

[Abstract] The duration of ore field formation means the overall duration of genetically related geological processes creating it. Kazakhstan has a long and complex history of development. Gold ore fields and deposits are

differentiated into monocyclic and polycyclic types. Monocyclic gold ore fields are predominant. The evolution of endogenous mineral formation in these fields has been primarily centripetal and inherited. An essential feature of polycyclic ore fields is the large size of the ore deposits, a result of the significant vertical propagation of industrially exploitable mineralization. There are characteristically skarn, copper-porphyry, pyrite-polymetallic, rare metal, sometimes rare-earth metal, boron, celestine-barite, fluorite and antimony-mercury deposits. The depth of mineral formation in each tectonic-magmatic cycle has varied. Later gold deposits are generally close to the surface. Foreign polycyclic deposits of similar type are discussed. The data presented on Kazakhstan gold deposits of general metallogenetic significance can be used in the study of other ore deposits as well. Figures 1, tables 1; references 17: 15 Russian, 2 Western.  
[54-6508]

UDC 553.07:551.72/73(574.3)

PRECAMBRIAN ORE FORMATIONS OF ULUTAU-ARGANATA, ITS PALEOZOIC SURROUNDINGS AND THEIR PROSPECTS

Alma-Ata IZVESTIYA AKADEMII NAUK KAZAKHSKOY SSR in Russian No 4, Jul-Aug 84 pp 13-27

KAIPOV, A.D., BENEVOLENSKIY, I.P., DZHUKEBAYEV, I.K., KALANCHIN, V.V. and NURALIN, N.N., Geological Sciences Institute imeni K.I. Satpayev, Kazakh Academy of Sciences, Alma-Ata

[Abstract] The Ulutau-Arganata region is still insufficiently known despite numerous geological survey operations. There are primarily metamorphic Precambrian formations here, beginning with lower Proterozoic series, consisting of crystalline shale, gneisses, amphibolites and quartzites. Lower Paleozoic deposits are present in the southwest portion of the region as terrigenous shale masses. Metallogenetic analysis of these varied Precambrian deposits is quite difficult due to the undeveloped stratigraphy of the Precambrian masses and multiple stages of ore deposit formation. This article presents a table of ore formations of the Precambrian and their Paleozoic surroundings. A number of genetic classes are represented, which the authors combine into three large groups: ore formations spatially and paragenetically related to metamorphosed Precambrian masses formed in the Proterozoic era; ore formations controlled by processes of tectonic-magmatic activation in later periods; and stratiformed copper and lead deposits enclosed in weakly dislocated carbonate-terrigenous Devonian and Carboniferous masses. A map of the location of promising ore fields in the area is presented. It is noted that further studies are needed to define the prospects of this area. Figures 4; references: 15 Russian.  
[54-6508]

## STRATIGRAPHY AND FACIES OF KAZAN DEPOSITS OF NORTHERN MARGIN OF CASPIAN DEPRESSION

Alma-Ata IZVESTIYA AKADEMII NAUK KAZAKHSKOY SSR in Russian No 4, Jul-Aug 84  
pp 43-49

BAKIROV, K.Kh., VALEYEV, D.Z., KOLUPAYEV, A.N. and DZHUMAGALIYEV, B.T.,  
Kazakh Scientific Research Geological Prospecting Institute, Gur'yev

[Abstract] A study was made of data from drilling of many deep boreholes in the Urals area, penetrating through the full thickness of deposits of the Kazan stage, as well as deep boreholes drilled in neighboring sectors of Orenburg Oblast. These studies showed the significant variability of the lithological composition of the stage upon movement in the latitudinal direction along the edge of the depression, with slight changes in a southerly direction. Two masses of deposits were found in the western portion of the territory, Carbonaceous lower and salt-bearing terrigenous upper. Their composition is described. Detailed analysis of the core material and geophysical studies allowed lines to be drawn between the eastern and western sections of the area. Oil and gas deposits are related to the Kalinov suite. Figures 2; references: 3 Russian.  
[54-6508]

UDC 550.834.53:553.982(574.1)

## PROCESSING OF SEISMIC DATA BY COMMON REFLECTION POINT METHOD FOR STRATAL MODEL

Alma-Ata IZVESTIYA AKADEMII NAUK KAZAKHSKOY SSR in Russian No 4, Jul-Aug 84  
pp 75-82

ISENOV, S.M., Kazakh Experimental-Methodological Expedition, Kazakh Geology Ministry, Alma-Ata

[Abstract] A discussion is presented of some specifics of practical implementation of the common reflection point method and criteria for selection of an optimum processing version. An iterative processing method, the common reflection point method retains the dynamic specifics of the signal. A unique scan of each boundary is obtained in the cross section, the horizontal axis corresponding to the length of the curved boundary of the model, while the time axis shows vertical time. Some results are presented from practical testing of the method using an actual seismic profile. The positive practical results of testing confirm the correctness of the theoretical assumptions made at the basis of the method and the correctness of criteria for selecting the optimum processing version and the stratal model of the medium used. Figures 2; references: 5 Russian.  
[54-6508]

# MODEL OF LINEAR PREDICTION OF SEISMIC SIGNAL IN STUDY OF THIN LAYER MEDIA WAVE FIELD STRUCTURES

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR, SERIYA B: GEOLOGICHESKIYE, KHIMICHESKIYE I BIOLOGICHESKIYE NAUKI in Russian No 8, Aug 84 (manuscript received 1 Nov 83) pp 21-24

KOVALEV, V.P. and TELEPNEV, G.F., 'Ukrgeofizika' Production Association, Poltava

[Abstract] The most accurate description of wave fields in thinly stratified media is provided by models based on probabilistic-deterministic theory. A linear parametric model with parameters which change with time is most convenient for application and interpretation. The seismic path is represented as the output of a linear system excited by a quasiperiodic sequence of pulses for birandom noise. In sufficiently short time intervals the model parameters can be considered constant. One of the major methods of studying the structure of the wave field in the model is spectral analysis. Classical spectral analysis methods do not serve satisfactorily due to their limited resolution. Recently, several new spectral methods have been developed with higher resolution, including the maximum entropy method. This method is applied assuming that the parameters of elementary waves are determined not by their spectra, but directly from the observed signal, and accordingly the accuracy of their evaluation and resolution are maximized. Equations derived in the article can be used in retrieving parameters of the geological cross section from seismic data observed at the surface. References 10: 8 Russian, 2 Western. [66-6508]

UDC 550.4:552.578:546.791

# DISTRIBUTION OF URANIUM IN SOLID BITUMENS BASED ON DATA OF FRAGMENTARY RADIOGRAPHY

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR, SERIYA B: GEOLOGICHESKIYE, KHIMICHESKIYE I BIOLOGICHESKIYE NAUKI in Russian No 7, Jul 84 (manuscript received 9 Sep 83) pp 20-22

SERGEYEV, I.P., and SHUMLYANSKIY, V.A., Institute of Geochemistry and Mineral Physics, Ukrainian Academy of Sciences, Kiev

[Abstract] Fragmentary radiography of sections was used to study the distribution of uranium in solid bitumens forming massive segregations, inclusions and thin veins in augulized and carbonatized sandstones. The sections, made with epoxy, were bombarded with a total neutron flux of  $2.6 \cdot 10^{15}$  N/cm<sup>2</sup>. The uranium content in the materials was determined from the density of tracks by comparison with standard specimens. Two groups of solid bitumens were found. The first group was deposited during



the first stage of mineralization, and contained scattered inclusions and microscopic veins of uranium minerals. This black bitumen consists of uranium-containing anthraxolyte, while the red and yellow bitumens in this group represent a higher kerite containing no high concentrations of uranium. The second group of solid bitumens consisting of colored soluble carbonaceous substances such as asphalt forms thin convoluted veins and circular accumulations in the sandstone. This group contains finely dispersed minerals of uranium creating a uranium-bearing edge around singularities. Microscopic bitumen inclusions in the third ore stage contain genetic transitions from the colored soluble to colored insoluble bitumens, which was not established in studies of bitumens in specimens. Figures 2; references: 2 Russian.  
[325-6508]

UDC 551.781/782:551.7(1)(470.318)

AGE AND CORRELATION OF STRATIGRAPHIC SUBDIVISIONS OF UPPER PALEOGENE AND NEOGENE IN WESTERN KAMCHATKA

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA GEOLOGICHESKAYA in Russian  
No 8, Aug 84 (manuscript received 26 May 83) pp 79-87

GLADENKOV, Yu.B., BRATTSEVA, G.M., SEROVA, M.Ya., and SINEL'NIKOVA, V.N.,  
Geology Institute, USSR Academy of Sciences, Moscow

[Abstract] The precise stratigraphic sequence of sedimentary masses along the Tochilinsk cross section and their clear exposure makes this section one of the most favorable objects for stratigraphic study in the entire North Pacific area. Considering the richness of paleontologic remains, it is not surprising that this section drew the attention of paleontologists long ago and has become the object of special study in recent years. Processing of materials collected in this area involves specialists from various scientific and production organizations of Moscow, Leningrad, Vladivostok, Magadan and Kamchatka. Processing of the data collected has generated new stratigraphic materials on this cross section. For the first time, a detailed combined paleontologic description of the late Cenozoic mass of Kamchatka has become available. A significant number of previously undescribed fossil forms has been found. Biostratigraphic analysis of the cross section was accompanied by a monographic description of the paleontologic remains. A detailed stratigraphic breakdown of the Late Paleogene-Neogene deposits of the cross section is presented. The experience of studying this cross section has shown what interesting conclusions can be obtained by combined analysis of paleontologic materials based on a monographic description of the fossil complexes and their characteristics by strata. Figures 1; references: 8 Russian.  
[41-6508]

## CORRELATION METHOD OF MICROMAGNETIC SURVEY

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEOLOGIYA I RAZVEDKA in Russian No 6, Jun 84 pp 77-83

BRODOVOY, V.V., BABAYANTS, P.S., and BULATOV, B.S., Moscow Geological Prospecting Institute imeni Sergo Ordzhonikidze

[Abstract] Magnetic field fluctuations caused by heterogeneous magnetism of rocks near the surface are dc magnetic effects. Their influence results from the random nature of distribution of magnetic heterogeneities at shallow depths and local manifestations in the magnetic field. The authors studied the nature of such fluctuations by means of micromagnetic measurements in areas measuring 10 x 10 and 20 x 20 m, using a network of micromagnetic measurements of 1 x 1 and 2 x 2 m. Due to the difficulty of large-area surveys, a method is suggested involving micromagnetic surveying in strips along the long axis of a structure. Microstrip observations are performed in a rectangular or triangular network. Strip surveying provides plans of micromagnetic anomalies and magnetic field graphs. Programs have been written for automatic processing of micromagnetic survey data. The next stage in testing the correlation method of micromagnetic surveying is to isolate and study tectonic fault zones. A further development of the correlation method would be the introduction of cryogenic magnetometers, magnetic gradient meters with short measurement bases and devices for measurement of weak magnetic properties of formations. The requirements of high precision micromagnetic surveying are outlined. Figures 3; references: 3 Russian.  
[53-6508]

UDC 532.529+624.131

## WAVES OF UNDERGROUND EXPLOSION

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNIЧЕСКОY FIZIKI in Russian No 3 (145), May-Jun 84 (manuscript received 21 Apr 83) pp 34-41

KRYMSKIY, A.V., and LYAKHOV, G.M., Moscow

[Abstract] Soil is modeled as a solid three-component medium containing free pore space filled with air, water and mineralized grains. This model is used to solve the problem of propagation of a spherical explosive wave in water-saturated soil. The stress in the soil decreases with increasing distance, significantly more rapidly if the soil is not water saturated. The explosive wave as it propagates also spreads and is converted from a shock wave into a continuous compressive wave. The model of the solid, multicomponent medium, considering the plastic properties and volumetric viscosity, provides a solution of the problem of propagation of a spherical explosive wave created by an underground explosion. The maximum stress, velocity of particles, propagation velocity of maximum stress and wave

profile at various distances from the point of the explosion, as well as radius of the explosive cavity are determined. Comparison with results of experiments performed in actual soils shows good agreement of all major parameters of the waves. Figures 6; references: 13 Russian.  
[23-6508]

#### SEISMOLOGY OF TOMORROW

Moscow ZNANIYE - SILA in Russian No 8, Aug 84 pp 20-22

NIKOLAYEV, A., doctor of physical mathematical sciences

[Abstract] Nikolayev discusses new methods in seismology and nontraditional approaches which are being developed. The old concept of the earth as a linearly elastic system and the assumption that seismic waves in the earth do not influence each other, and that their behavior is independent of intensity, with the earth considered a passive object transmitting the energy of the waves without radiating waves, is being modified. New areas of seismology, including the generation of seismic waves by non-explosive vibrators, as well as storm waves and other natural sources, are being utilized for new types of seismology, particularly long-distance and holographic seismology. The holographic construction of images of the earth based on the waves previously considered only noise is an important new trend. Figures 2.

[38-6508]

UDC 550.834

#### INTERPRETATION OF SURFACE REFRACTED WAVE TRAVEL-TIME CURVES

Novosibirsk GEOLOGIYA I GEOfIZIKA in Russian No 6, Jun 84 (manuscript received 10 May 83) pp 111-117

SUVOROV, V.D., Geology Institute, Yakutsk Affiliate, Siberian Department, USSR Academy of Sciences, Yakutsk

[Abstract] An approximate method is suggested for obtaining a solution in analytic form in a model of a local flat division boundary assuming homogeneous underlying and overlying masses for the problem of determining the direction of the strike, dip of the boundary and boundary velocity. The accuracy of the method, based on surface travel-time curves of refracted waves obtained from three sources, is estimated. The problem is also solved when two sources of excitation are used. The data indicate the possibility of practical utilization of the method of interpreting surface travel-time curves of refracted waves obtained from three sources of excitation. Figure 1; references: 5 Russian.

[17-6508]

## ENGINEERING SEISMOGEOLOGY OF SEVERO-MUYSK INTERRIFT BARRIER (BAIKAL RIFT ZONE)

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 6, Jun 84 (manuscript received 21 Jun 83) pp 3-15

SOLOMONENKO, V.P., DEM'YANOVICH, M.G. and ANDEYEV, V.A., Earth's Crust Institute, Siberian Department, USSR Academy of Sciences, Irkutsk

[Abstract] The seismicity of the upper Angara-Muysk (Severo-Muysk) inter-rift barrier in the Baikal rift zone has been estimated as 9 scale units or even higher. Seismogeologic studies in this area have revealed epicentral zones of 7 large earthquakes. The upper Angara-Muysk barrier is among the most complex in the Baikal rift zone and is seismically the most active. The development of physical-geological processes in this area is facilitated by a thick zone of weathering of rock, many faults, hydrothermal activity and frequent earthquakes. One of the major causes of activation of seismogravitational processes can be found in the seismic accelerations, acting as if the natural slope angle of planes of separation of slides and avalanches were increased. The Severo-Muysk interrift barrier is a region with unfavorable engineering-geological conditions. The Baikal-Amur main rail line is constructed over much of its length under unusual engineering-geologic conditions: high seismicity and complex permafrost. The construction of the railroad in general, and the Severo-Muysk tunnel in particular, must be considered a unique engineering-seismologic experiment. The experience of construction of the BAM line must be considered in planning of new railroad lines in Siberia, the Far East and the Northeast, as well as in other high-seismicity areas in the USSR. Figures 4; references 38: 37 Russian, 1 Western.  
[17-6508]

UDC 550.834

## DETERMINATION OF COORDINATES OF SEISMIC OBSERVATION POINTS BY SOUND DIRECTION FINDING

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 6, Jun 84 (manuscript received 10 Jun 83) pp 127-129

YELISEYEV, B.A., MASHINSKIY, E.I., SAPRYKIN, S.N. and VEDERNIKOV, G.V., Geology and Geophysics Institute, Siberian Department, USSR Academy of Sciences, Novosibirsk

[Abstract] A study is made of a method of determining the coordinates of observation points on the ground using the sound direction finding principle. In an area with seismic detectors of any configuration there are at least two, usually three points of excitation of sound waves, the coordinates of which are preliminarily determined by tying into the geodetic



network. Sound signals are alternately radiated at these points and alternately recorded by all seismic detectors. Based on the known speeds of sound in air and arrival times of direct waves from each source, the distance between the sound source and seismic detectors can be calculated. Coordinates on the ground can then be determined for any seismic detector by determination of its distance to at least two excitation points. The method allows highly accurate determination of the coordinates of large numbers of observation points in any configuration without additional hardware. The method should be most effective when multichannel telemetry systems are used to collect and process seismic information, including a microcomputer allowing automatic computation and determination of the coordinates of observation points in the field. Figures 2: references: 3 Russian.

UDC 528.02

# CONDITIONALITY OF NORMAL EQUATION MATRICES IN CERTAIN METHODS OF ADJUSTING GEODETIC NETWORKS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY. GEODEZIYA I AEROFOTOS"YEMKA in Russian No 3, May-Jun 84 (manuscript received 18 May 81) pp 32-35

GERASIMENKO, M.D., docent, candidate of technical sciences, Far Eastern State University

[Abstract] A study is presented of the properties of matrices and the behaviors of their conditionality numbers in the computation process. The conditionality numbers allow analysis of the influence of accuracy of determination of the initial system of equations and limiting errors on the final calculation results. Formulation of a reduced system of normal equations is found not to lessen theoretical strictness of solution of the adjustment problem, while significantly decreasing the volume of computation, allowing determination of weighting coefficients of adjustment coordinates and simultaneously maintaining conditionality of the matrix of coefficients of normal equations as in the initial problem. References: 3 Russian.  
[28-6508]

# CONSIDERATION OF HETEROGENEITY OF GRAVITY FIELDS IN LOCAL HIGH PRECISION GEODETIC CONSTRUCTIONS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, GEODEZIYA I AEROFOTOS"YEMKA in Russian No 3, May-Jun 84 (manuscript received 23 Oct 82) pp 66-72

KONOPIKHIN, A.A., docent, candidate of physical mathematical sciences; OGORODOVA, L.V., docent, candidate of technical sciences, and YUZEFOVICH, A.P., docent, candidate of technical sciences, Moscow Order of Lenin Institute of Geodetic, Aerial Mapping and Cartographic Engineers

[Abstract] The authors' institute has undertaken a series of studies to estimate the influence of heterogeneity of the gravity field on measurement of elements of local geodetic constructions and methods for their examination. Numerical estimates are made using a gravimetric survey of the plains region in the central zone with a density of 5 to 6 stations per square kilometer. Total survey area is about 40 square kilometers. The detailed survey allows determination of local values of elements of the gravitational field, i.e., those caused by gravity anomalies in the immediate vicinity of the geodetic station. It is also possible to obtain information on changes in these elements over comparatively short distances, characteristic for local high-precision geodetic constructions. In the plains region with a quiet gravitational field, corrections for heterogeneities over distances of 50 to 100 m are comparable with the accuracy of the geodetic measurement. Computation of the precise values of the corrections at each station in the network requires calculation of the radius of the area of anomalies considered, calculation of the necessary density of survey in the immediate neighborhood of stations, and execution of a gravimetric survey. Variometric observations can also be used to consider heterogeneities in the gravity field. Figures 2; references: 1 Russian. [28-6508]

UDC 528.024.1

# MATHEMATICAL MODELING OF RESULTS OF GEOMETRIC LEVELING IN VARIABLE GRAVITY FIELD

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, GEODEZIYA I AEROFOTOS"YEMKA in Russian No 3, May-Jun 84 (manuscript received 8 Jun 83) pp 72-75

VOVK, I.G., docent, candidate of technical sciences, Novosibirsk "Emblem of Honor" Institute of Geodetic, Aerial Mapping and Cartographic Engineers

[Abstract] Changes in elevation recorded during geometric leveling may result either from vertical movement of the crust or movement of level surfaces due to change in gravitational potential. Without analyzing changes in the force of gravity it is therefore impossible to draw a proper conclusion not only concerning the magnitude and rate of movement of the crust, but also whether such movement has actually occurred. The task of considering the influence of variations in the gravity field on the results of

geometric leveling is complicated if changes in the field occur during field operations. The use of mathematical modeling methods to solve the problem allows preestimation of possible changes in normal elevations along a level line and determination of the need for gravimetric work. If changes in the gravity field can be reliably estimated using a model, as is the case in the vicinity of reservoir, mathematical modeling methods based on experimental data on factors influencing changes in the field allow estimation of changes in normal elevations without making gravity determinations. Figures 2; references: 4 Russian.  
[28-6508]

UDC 528.7

#### RELATIONSHIP BETWEEN BRIGHTNESS SPECTRUM OF PHOTOGRAPHIC IMAGE AND SPECTRUM OF RISES ON A WATER SURFACE WITH WAVES

Moscow IZVESTIYA VISSHIKH UCHEBNYKH ZAVEDENIY, GEODEZIYA I AEROFOTOS"YEMKA in Russian No 3, May-Jun 84 (manuscript received 8 Jul 83) pp 90-95

STRIZHKIN, I.I., docent, candidate of technical sciences, MALINNIKOV, V.A., candidate of physical mathematical sciences and LAPCHINSKAYA, M.P., engineer, Moscow Order of Lenin Institute of Geodetic, Aerial Mapping and Cartographic Engineers

[Abstract] A method has been recently developed for determination of the wave spectrum of a water surface by spectral analysis of sea surface photographs and utilization of the transfer function between the spectrum of slopes and the spectrum of rises. Various methods are possible for determining the slopes of spectrums from photographs: determination of height of surface profiles using stereoscopic pairs and statistical processing of data or microphotometry of an individual photograph. The methods using individual photographs are preferable. The interrelationship between the slope spectrum and the spectrum of rises is analyzed in this article. Factors influencing the formation of the photographic image of a wave and thus the slope spectrum are studied. The influence of the survey scale on the slope spectrum is analyzed. The influence of illumination conditions on the slope spectrum is discussed. The influence of illumination conditions must be considered in determining the requirements for photographic surveying of waves to decrease distortions. The recommendations in the article were used to process materials from stereoscopic photographic wave surveys at a 1:160 scale in the Caspian Sea from a nonmoving platform. Comparison of rise spectra yielded acceptable results. Figures 4; references 7: 5 Russian, 2 Western.  
[28-6508]

## STUDY OF PHASE RADIOGEODETIC SYSTEMS WITH PHASE-LOCKED LOOPS

Moscow IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY, GEODEZIYA I AEROFOTOS"YEMKA in Russian No 3, May-Jun 84 (manuscript received 3 Nov 81) pp 14-20

GLUMOV, V.P., docent, candidate of technical sciences, Moscow Order of Lenin Institute of Geodetic, Aerial Mapping and Cartographic Engineers, GOLOD, O.S., docent, candidate of technical sciences and SIZOV, V.V., engineer, Northwest Polytechnical Institute; TER-SAAKOV, E.I., candidate of technical sciences, All-Union Marine Geology and Geophysics Scientific Research Institute

[Abstract] Phase-type difference systems with a two-channel compensation station are widely used in the creation of geodetic bases at sea. To increase the operating range of such systems and the accuracy of measurements made with them, balance and single-side band modulation is used in the reference channel. Synchronous detectors with phase-locked loop are used for the same purpose. One effective method of expanding the interception band of phase-locked loops is discrete phasing of the tuned oscillator by the input signal. This article describes the discriminating characteristics of an open phase-locked loop with periodic phasing of the tuned oscillator by the input signal and a sawtooth phase detector characteristic. The analysis provides a basis for selection of operating conditions of a phase-locked loop in a system which can help to optimize operating conditions of radiogeodetic systems.

Figures 2; references: 3 Russian.

[28-6508]

UDC 551.21+550.3

## ASACHA EARTHQUAKE SWARM AND ITS NATURE (KAMCHATKA, MARCH-APRIL 1983)

Moscow VULKANOLOGIYA I SEISMOLOGIYA in Russian No 3, May-Jun 84 (manuscript received 15 Oct 83) pp 3-13

TOKAREV, P.I., Volcanology Institute, Far Eastern Scientific Center, USSR Academy of Sciences

[Abstract] A swarm of earthquakes began on 7 March 1983 in the neighborhood of extinct volcanoes of the Asacha group situated at a distance of 90 km to the south of Petropavlovsk-Kamchatskiy. A table gives the characteristics of earthquakes of the Asacha swarm registered by seismic stations in Southern Kamchatka. Figure 2 shows the location of the seismic stations, the epicentral zone of the Asacha earthquake swarm, active and extinct volcanoes and locations of radiotelemetric stations. The center of the swarm was at the approximate coordinates 52°18'N, 157°53'E. In most cases the focal depth was approximately 10 km, with the foci being concentrated in a small region. The development of the swarm in time (four discrete stages are discriminated) and the frequency of recurrence of



tremors is discussed. Monitoring of these events is described. A special section is devoted to prediction of the swarm and volcanic activity. All the considered characteristics of the Asacha swarm indicate that it was evidently associated with the injection of magma at a depth of about 10 km. It can be expected that such swarms may occur in this region repeatedly over the course of several years. They are not a precursor of an eruption. Volcanic earthquakes of types II and III in the energy class  $K \geq 9.0$  will appear in the case of preparation for an eruption not less than one week before its onset. The occurrence of such earthquakes will indicate the possibility of an eruption. In the course of observations a series of good and poor features of the monitoring system became apparent. It was possible, for example, to make predictions of the state of the volcano for the coming week (these predictions were successful). Figures 4, tables 1; references 14: 10 Russian, 4 Western.  
[237-5303]

UDC 551.215

#### ASACHA GROUP OF VOLCANOES ON KAMCHATKA

Moscow VULKANOLOGIYA I SEISMOLOGIYA in Russian No 3, May-Jun 84 (manuscript received 24 Jun 83) pp 14-24

KOZHEMYAKA, N.N., LITASOV, N.Ye. and VAZHEYEVSKAYA, A.A., Volcanology Institute, Far Eastern Scientific Center, USSR Academy of Sciences

[Abstract] The Asacha volcano group is situated 90 km to the south of Petropavlovsk-Kamchatskiy near the active volcanoes Gorelyy and Mutnovskiy; this is a poorly studied region. An unexpectedly strong swarm of earthquakes of a volcanic-tectonic nature began in the neighborhood of Zheltyy volcano in March 1983. During the period 7-17 March several tens of tremors were registered each day at a distance of 10 km from the epicenter. The article gives a brief description of the geological structure and volcanism of the Asacha complex. The study is based on field observations by the authors in 1968. Available data and repeated interpretation of aerial photographs were used in compiling a geological map of the Asacha group, defining recent tectonic dislocations which had not been mapped earlier and determining areas and volumes of volcanites. (Figure 1 is a tectonic map of the region; Fig. 2 is a corresponding geological map.) The petrology of individual volcanic formations is also described, followed by a discussion of the geological history of the region. Taking into account the history of geological development and the strong and prolonged nature of the earthquake swarm in March 1983 it is visualized that volcanic activity may be renewed in the future. It is not by chance that the largest field of areal volcanism was formed on the northeasterly continuation of the weakened zone of the Asacha complex. Taking into account the nature of the most recent manifestations of volcanism, represented by small slag and lava cones of the monogenic type, in the near future one or more formations of this same type may be formed on the northern slope of Zheltyy volcano on the continuation of the already forming chains of slag cones.

Figures 3; references: 22 Russian.

[237-5303]

# **THERMOHYDRODYNAMIC MODEL: HYDROTHERMAL SYSTEM - SHALLOWLY SEATED MAGMA CHAMBER**

Moscow VULKANOLOGIYA I SEYSMOLOGIYA in Russian No 3, May-Jun 84 (manuscript received 20 Apr 83) pp 25-34

KIRYUKHIN, A.V., Volcanology Institute, Far Eastern Scientific Center, USSR Academy of Sciences

[Abstract] The results of numerical modeling of heat exchange in the Hawaiian geothermal reservoir published by P. Cheng and K. Lou (GEO-THERMICS, Vol. 2, No 3-4, pp 90-94, 1973) demonstrate the possibility of appearance of a hydrothermal system over a magma chamber, but this and other investigations along these lines have failed to yield a convincing model (Cheng and Lou, for example, were unable to explain how a magma chamber could retain its parameters over a very long time). This matter was investigated further in the Pauzhetskaya hydrothermal system, since the initial data required for the computations are readily available. (Figure 1 is a block diagram of the Pauzhetskaya volcanotectonic depression.) The equations for the conservation of mass and energy are fully discussed. Computations were made for two possible variants of interaction between the magma chamber and the hydrothermal system: stationary "dry" magma chamber and "dry" magma chamber changing volume in dependence on the discharge of magma and taking into account heat exchange with the surrounding rocks. The initial data for the computations are tabulated. It is shown that the thermal supplying of the hydrothermal system can be ensured by the extraction of heat from a magma chamber which lies at a depth of 3 km and is melted out due to receipt of 40 km<sup>3</sup> of basalt melt with a temperature of 1,300°C. A constant temperature of 1,000°C is stipulated at the magma chamber - hydrothermal system boundary; this is equal to the temperature in the chamber. Computations made using the model developed in this article with initial data corresponding to the Pauzhetskaya hydrothermal system give temperature values in the geothermal reservoir and a natural heat transfer comparable with the actually observed values. Figures 8, tables 1; references 18: 13 Russian, 5 Western. [237-5303]

UDC [551.211:551.79](571.66)

## **LATE QUATERNARY AREAL VOLCANISM OF KUMROCH RANGE (EASTERN KAMCHATKA)**

Moscow VULKANOLOGIYA I SEYSMOLOGIYA in Russian No 3, May-Jun 84 (manuscript received 16 Jun 81) pp 57-66

USPENSKIY, V.S. and SHAPIRO, M.N., Kamchatgeologiya Geological-Production Association; Earth Physics Institute, USSR Academy of Sciences

[Abstract] The East Kamchatkan zone of Quaternary volcanites extends in a northeasterly direction from Cape Lopatka to the Tumrok and Gamchen Ranges.

The Kumroch Range, on its northeasterly continuation, is almost without significant manifestations of Quaternary volcanism, but on the eastern slopes of the range there are small sectors with Quaternary basaltoids. Geological survey and specialized studies in 1975 and 1977 yielded new data on this area. Figures 1, 2 and 3 show the location, geomorphological features and structure of the investigated area. Different sections are devoted to the geological position and structure of basaltic bodies, age of volcanism in the area, composition of volcanites and a comparison of the basalts of the Kumroch Range and other areal basalts of Kamchatka. The Kumroch basalts differ from the other areal basalts of Kamchatka in having a predominance of magnesian varieties with an increased (50-54%)  $\text{SiO}_2$  content. The  $\text{K}_2\text{O}$  content in these basalts (0.7-2.6%) is not less than in the magnesian areal basalts of the same age in the Central Kamchatka Depression and the Central Range, situated considerably farther from the axis of the abyssal trench. The transverse zonality in the content of alkalis and especially potassium commonplace for island arcs cannot be detected in the Kumroch Range. Figures 5; references: 20 Russian.  
[237-5303]

UDC 528.484:551.21

# DEFORMATIONS OF EARTH'S SURFACE IN TOLBACHINSK GEODYNAMIC POLYGON DETERMINED FROM GEODETIC DATA (1976-1977)

Moscow VULKANOLOGIYA I SEYSMOLOGIYA in Russian No 3, May-Jun 84 (manuscript received 16 Dec 82) pp 67-72

SHAROGLAZOVA, G.A.

[Abstract] A repeated cycle of geodetic work was carried out in 1977 in the Tolbachinsk geodynamic test area. The work included measurements of horizontal angles under a second-order triangulation program, measurement of triangulation sides under a first-order base measurement program, second-order geometric leveling and trigonometric leveling. This work made possible an analysis of horizontal deformation of the earth's surface and vertical displacements of points on the earth's surface within the test area. According to geodetic data for 1976-1977, within this area there were significant horizontal deformations near the Novyye slag cones and in the south-southwestern sectors of the test area. Compressional deformations are observed in the neighborhood of the Northern Break, in the sector between the Northern Break and Ploskiy tolbachik volcano and in the peripheral sector to the west of the Southern Break. Their absolute values exceed by a factor of 1.4 the dilatational deformations registered in the Tolbachinsk test area during this break. The dilatational deformations tend to be located near the Southern Break. The deformational forces are operative for the most part across the strike of the main fissure passing through the newly forming slag cones. A comparison of leveling data for 1976-1977 reveals a decrease of the earth's surface in a south-southeasterly direction from the Northern Break, which agrees with independent tiltmeter observations.  
Figures 4; references 11: 10 Russian, 1 Western.  
[237-5303]



# GEODETIC MEASUREMENTS DURING ERUPTION OF ALAND VOLCANO (KURIL ISLANDS) IN 1981

Moscow VULKANOLOGIYA I SEYSMOLOGIYA in Russian No 3, May-Jun 84 (manuscript received 13 Jan 83) pp 73-81

TSELISCHEV, V.S. and CHEKHUT, V.V., Volcanology Institute, Far Eastern Scientific Center, USSR Academy of Sciences

[Abstract] Aland volcano on Atlasova Island is the most northerly and most active of the volcanoes on the Kuril Islands. A summit eruption of this volcano occurred in 1981. Geological, geophysical and other data have been presented in other sources. This article is limited to an interpretation of geodetic measurements made during the period 8 May-24 June 1981 during and after the eruption. Measurements were made in the southeastern part of the island. Field work was carried out in two stages. There were four complete cycles of measurements of polygonometric lines and angles and relative elevations were measured 19 times in the area where leveling was carried out. The data revealed that the eruption was accompanied by horizontal and vertical movements of earth's surface. The results of measurements of polygon sides made it possible to determine the region in which considerable horizontal deformations were possible. The results of measurements of relative elevations in the leveled area were used in plotting a curve of tilts of the earth's surface. A correlation was established between tilts of the earth's surface and phases of the eruption. During the active stage of the eruption the tilts had a sign-variable character; they were significant in magnitude and their directions were parallel to the direction of the volcanic crater. The greatest registered tilt was 15 urad. After the end of the active stage of the eruption the tilt for some time decreased but then began to increase in a direction forming an angle of approximately 30° with the direction of the sign-variable tilts, sometimes resuming its former nature. These data do not fully reflect the patterns of movements of the earth's surface in the neighborhood of Aland volcano because the measurements covered only a small part of the territory near the volcano. Figures 4, tables 3; references: 7 Russian. [237-5303]

# LENGTH OF NEAR-SURFACE FISSURE FEEDING CONES OF NORTHERN TOLBACHIK BREAKTHROUGH

Moscow VULKANOLOGIYA I SEYSMOLOGIYA in Russian No 3, May-Jun 84 (manuscript received 3 Mar 81) pp 82-87

VIKULIN, A.V., Physics of Earth Institute, USSR Academy of Sciences

[Abstract] In an earlier study the concepts of deep and surface fissures were defined. Since in this article a study is made of the change in



configuration of the fissure feeding the cones of the northern Tolbachik which is situated at some intermediate depth interval, the new term "near-surface fissure" has been introduced. During the course of formation of these cones at the time of the eruption of 1975 it was possible to estimate the width of the fissure at the surface at the time of its appearance (about 1 m) and the length of the deep feeding fissure (not less than 4 km). Deep seismic sounding revealed that at a depth of about 1.2-1.3 km there is a discontinuity with a velocity jump  $\Delta V = 2.5-4.4$  km/sec. These and other seismic data gave a theoretical estimate of the length of the fissure at a depth of 1.2-1.3 km of 0.3-1.3 km. A solution of this problem was also sought on the basis of data on pressure in the duct. This required a knowledge of the excess pressure in the duct, the Young coefficient  $E$  and the Poisson coefficient  $\nu$ ; the very same length, 1.3, was obtained. Still another approach to the same problem, based on the volume of discharged material, once again gave a length of the near-surface fissure of 0.8-1.3 km. It was possible to formulate a model of the processes transpiring in the upper part of the duct during a stationary explosive eruption. It is postulated that in the feeding duct at a seismic boundary with a great velocity jump of longitudinal waves, at a depth 1.2-1.3 km, there is a vertically thin layer within which there is an intensive release of volatiles from magma. In the neighborhood of the breakthrough, in submeridional and sublatitudinal directions, there is a spatial periodicity of slag cones with a period equal to the length of the near-surface fissure. This is a manifestation of the stress field characteristic of this region associated with the injection of magma. Figures 1, tables 1; references: 26 Russian. [237-5303]

UDC 552.12+548.4

# GAS PHASE COMPOSITION OF ACIDIC LAVAS IN UZON-GEYZERNYY REGION (BASED ON RESULTS OF STUDY OF MICROINCLUSIONS)

Moscow VULKANOLOGIYA I SEYSMOLOGIYA in Russian No 3, May-Jun 84 (manuscript received 18 Feb 83) pp 87-90

GRIB, Ye.N. and SHUGUROVA, N.A., Volcanology Institute, Far Eastern Scientific Center, USSR Academy of Sciences; Geology and Geophysics Institute, Siberian Department, USSR Academy of Sciences

[Abstract] The Uzon-Geyzernyy volcanotectonic depression on Kamchatka is characterized by extensive development of the products of acidic volcanism. In the Quaternary there were three cycles of magmatic activity, each beginning with the outpouring of andesites and dacites and ending with flows and extrusions of liparitic composition. The great number of inclusions and lenses of basalts and their crystalline fragments encountered in acidic lavas indicate that the reason for the nonequilibrium state of mineral associations in acidic volcanites is a mixing of magma melts during injection of basalts into a crustal chamber. During the crystallization of magma microportions of melt are trapped by impregnations of minerals and during

retrograde boiling purely gas bubbles are also captured. The composition of the gas phase was determined by ultramicrochemical analysis of individual inclusions. There is evidence that the retrograde boiling of the melt was sporadic. The temperature at which the gas inclusions were captured can be estimated. The diameter of the gas inclusions varies from 5 to 50  $\mu\text{m}$ . The most characteristic gas components are nitrogen + rare gases and  $\text{CO}_2$ . Three different cycles were defined and the distinctive characteristics of each were discriminated. The acidic lavas contain plagioclase impregnations whose crystallization occurred at different depths, both in independent magma chambers at depths of 30 and 5 km and in the duct near the surface directly prior to emergence of lava at the surface. The crystallization of some of the plagioclase impregnations at high pressures is indicated by the existence of two-phase gas inclusions containing nitrogen. The nonuniformity of acidic lavas associated with the injection of deep high-temperature basalts into the crustal chamber of acidic magma situated above, revealed by petrological and thermometric methods, is also confirmed by the composition of the gas inclusions trapped by plagioclases during retrograde boiling of the melt. Tables 1; references: 7 Russian. [237-5303]

UDC 551.24+551.73+552.11+552.321

# PALEOZOIC MAGMATISM AND GEODYNAMICS IN NORTHERN SECTOR OF CENTRAL ASIAN FOLDED ZONE

Novosibirsk GEOLOGIYA I GEOfIZIKA in Russian No 4, Apr 84 (manuscript received 16 Jun 83) pp 91-31

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[Abstract] Much has already been published concerning the history of geological development of the Paleozoic in the light of the new global tectonics and during the last few years much new material has been published on the magmatism and tectonics of the folded margin of the southern part of the Siberian Platform and Mongolia which has made it possible to supplement or reexamine prevailing concepts concerning the history of geological development of this particular region during the Paleozoic. Figure 1 is a paleotectonic map of the Vendian-Early Paleozoic; Fig. 2 is a diagrammatic representation of petrochemical features of Vendian-Cambrian oceanic, island arc and continental basalts; Fig. 3 is a paleotectonomagmatic diagram of the Middle Paleozoic; Fig. 4 represents petrochemical features of Upper- and Middle Paleozoic oceanic and island arc basaltoids; Fig. 5 is a paleotectonic diagram of the Upper Paleozoic. The presented material on Paleozoic magmatism in this area is consistent with the fundamental principles of the new global tectonics. The spatial-temporal changes in the composition of Vendian-Lower Paleozoic magmatism, its structural-formation diversity, the presence of abyssal trenches, complex island arcs, an extensive shelf, marginal and internal relict seas surrounded by prominences in the Precambrian basement, all this is indicative of close geodynamic conditions similar to those existing in the Ceno

zoic along the western margin of the Pacific Ocean. In the Middle and Late Paleozoic volcanoplutonic zones of complex composition, regenerated internal and marginal seas and subduction zones were formed on the continental margin of the Siberian continent where the absorption of the oceanic spaces of Paleothetis, formation of island arcs and growth of the Siberian continent occurred. The geodynamic conditions of that time were close to those existing along the western and eastern margins of the Pacific Ocean. Figures 5; references 37: 35 Russian, 2 Western.  
[238-5303]

UDC 550.361(571.1)

#### RESULTS OF GEOTHERMAL WORK IN SOUTHERN REGIONS OF WEST SIBERIAN PLATE

Novosibirsk GEOLOGIYA I GEOPHIZIKA in Russian No 4, Apr 84 (manuscript received 25 May 83) pp 78-88

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[Abstract] The results of geothermal work carried out in Novosibirsk, Omsk, Kurgan and Petropavlovsk Oblasts during 1979-1982 are presented. All available data were used, one of the objectives being prediction of temperature in the earth's crust. Data from 400 boreholes (depths 0.1-4.5 km) were used. Thermal conductivity of more than 500 samples of rocks from the sedimentary complex, intermediate levels and the basement were studied. Heat flow was ascertained at a total of 170 points. Maps of the distribution of the heat flow and temperature at depths of 1 and 5 km in the southern regions of the West Siberian Plate were compiled. These provide information on the background levels and regional variations of heat field parameters in this territory. Using all these data the geothermal method can be used in estimating temperature conditions at great depths and observational data can be used in studying the relationships between the heat field and surface and deep structure of the territory. Such materials can be used in discriminating geothermally promising regions for seeking deposits of hydrocarbons and thermal waters, as well as in the designing of instrumentation for investigating boreholes. These data make it possible to evaluate changes in temperature conditions in the section and to make more precise determinations of thermodynamic conditions in the intervals of formation of hydrocarbon deposits, as well as prediction of depth change in the phase state of the hydrocarbons. The work accomplished will serve as a basis for more detailed geothermal work in promising areas. Figures 1, tables 2; references: 15 Russian.  
[238-5303]

## POLYNOMIAL PARAMETERIZATION IN INVERSE GRAVIMETRIC PROBLEM

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 4, Apr 84 (manuscript received 7 Apr 83) pp 99-105

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[Abstract] An algorithm for solution of the inverse gravimetric problem (plane case) is formulated. On the basis of a polynomial parameterization it makes it rather easy to formalize and take into account a priori data on the configuration and position of an anomaly-forming object. The plane inverse gravimetric problem is formulated in the following way. The values of the anomalous field  $g = \{g(x_1), \dots, g(x_N)\}$  are measured along a profile perpendicular to a two-dimensional body. The excess (relative to the surrounding medium) density of the body  $\rho$ , its anomalous mass, left and right edges and the restricted half-space in which the body is situated are considered known. It is required that the form and position of its upper and lower surface be determined. In such a formulation the problem has a unique solution and can be used in ore geophysics. The algorithm was tested in test models and in interpretation of the gravity field along one of the profiles in the Ozerninskoye deposit in Western Transbaykalia. The model experiments indicated that the algorithm rather rapidly (with the 5th-6th iteration) converges to a precise solution. The algorithm has a high noise immunity. In an interpretation in three-dimensional space the polynomials  $P_m(x)$ ,  $Q_n(x)$  must be replaced by their spatial analogues. After appropriate changes the algorithm can be used in interpreting magnetic prospecting data. Figures 2; references: 14 Russian. [238-5303]

UDC 550.341(571.5)

## EARTHQUAKE FOCAL MECHANISM IN NORTHERN MUYA REGION OF BAYKAL RIFT ZONE

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 4, Apr 84 (manuscript received 10 May 83) pp 105-113

MISHARINA, L.A., SOLOVENKO, N.V. and MEL'NIKOVA, V.I., Earth's Crust Institute, Siberian Department, USSR Academy of Sciences, Irkutsk

[Abstract] New data on the focal mechanism of earthquakes in the Northern Muya region of the Baykal rift zone, bounded by the coordinates 55°00'-56°50' N and 113°00'-114°10' E, were obtained during the period 1977-1979 after establishment of a local network of eight seismic stations for studying seismic conditions in relation to construction of the Baykal-Amur Railroad Line. It is now possible to give more detailed information on the stressed state and displacements at earthquake foci in this region than was available earlier from the Baykal regional network. The earthquake focal



mechanisms were determined on the basis of data on the signs of displacements in the first arrivals of longitudinal waves and using the so-called group method, based on the concept of an identity of processes in closely spaced foci. Use was made of data on 439 earthquakes, including 254 registered during 1977-1979. Tables 1 and 2 give the orientation of the axes of the main stresses at the foci of groups of earthquakes and individual earthquakes. An analysis of these data reveals that at the foci of 71% of these earthquakes the axes of compressional stresses are oriented in a near-vertical direction; in 86% of the cases the axes of dilatational stresses are near-horizontal. Figure 4 shows the strikes of possible fault planes at earthquake foci corresponding to systems of active tectonic dislocations. A system of focal faults having a maximum with  $Az = 90^\circ$  is most common in the region because these faults are manifested in virtually all sectors of the epicentral field. The movements at the foci of weak earthquakes in this region occur along dislocations in the crust corresponding to definite tectonic directions. Figures 4, tables 4; references: 7 Russian.  
[238-5303]

UDC 550.837.3

#### PRIMARY PROCESSING OF EXPERIMENTAL MAGNETOVARIAION SOUNDING DATA USING SPLINE FUNCTIONS

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 4, Apr 84 (manuscript received 23 Mar 83) pp 120-124

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[Abstract] The following problem arises in the processing of various kinds of observational data. A continuous smooth curve must be best plotted in a cloud of experimental points on a plane. The objective of this study was an examination of the problems related to approximation of a cloud of impedance values in the example of data from deep magnetovariation sounding. The problem is formulated as follows. The impedance values  $\rho_T(T)$  (where  $T$  is the period) obtained with some error on the basis of observations at a broad network of geomagnetic observatories are represented in a cloud of points  $\{\rho_T(i)(T_k)\}$ ,  $i = 1, 2, \dots, m_k$ ,  $k = 1, 2, \dots, L$ , on the plane  $(T, \rho_T)$ , where  $L$  is the number of periods of observations,  $m_k$  is the number of  $\rho_T$  values in the period  $T_k$ . The poor values  $\rho_T(i)$ ,  $i = 1, 2, \dots, m_k$  are excluded for each period. This is accomplished by examining the  $\{\rho_T(i)\}$ ,  $i = 1, 2, \dots, m_k$  values as possible values of the random parameter  $R_k$ ,  $k = 1, 2, \dots, L$ . Then the scatter  $\delta_k$  of the  $R_k$  value about its mean value is computed. In this formulation and with the above point of departure, an algorithm is developed for the continuous approximation of the cloud of points on a plane in the form of a cubic spline. Figures 1; references: 5 Russian.  
[238-5303]

## APPLICATION OF FIELD X-RAY - RADIOMETRIC ANALYSIS IN EXPLORATORY GEOLOGY AND MEANS FOR ITS IMPROVEMENT

Leningrad, VESTNIK LENINGRADSKOGO UNIVERSITETA: GEOLOGIYA, GEOGRAFIYA in Russian No 6, Issue 1, Mar 84 (manuscript received 10 Mar 83) pp 96-100

BARKHATOV, D.B. and BUTOMO, N.I.

[Abstract] New developments in field x-ray - radiometric analysis in application to the field of geology have become possible due to continued improvement in microcomputers. The speedy collection and on-the-spot processing of geological and geophysical data has become possible in such regions as the Arctic. Such work was recently carried out in the Arctic in a region of complexly folded Proterozoic strata in a zone with a length of 250-300 km and a width of 20-30 km. The objective was studying metallogenetically promising complexes and formations and detection of shows of mineral raw materials. Experimental work with RRK-103 apparatus was carried out during 1980-1982. It was possible to detect concentrations of copper, zinc, lead, rubidium and zirconium; 400 samples were obtained. The end product of this work was geochemical maps of the region and correlation graphs of the content of a number of elements in the sections. However, the RRK-103 was found to have a number of limitations: limited mobility and inability to ensure multicomponent analysis of samples and there is no device for automatic calculation of the concentration of elements determined. These shortcomings have been overcome by use of the specialized "Elektronika S5-21" computer weighing 1 kg (with attachments 3-5 kg). It is ideal for field work due to small size, low weight, small required power and considerable storage capacity. The computer complex (Fig. 1 is a block diagram with 14 identified components) controls the entire measurement process and the accumulation of spectrometric data. The X-ray sensor is coupled to the microcomputer by a device for converting analog spectrometric data into digital form. The outfit stores and analyzes the entire spectrum of characteristic radiation and increases the number of simultaneously identifiable elements. Speed is increased by an order of magnitude. In 1-2 minutes it is possible to determine the concentration of five elements simultaneously with a response 0.02%. Figures 2; references: 5 Russian.

[225-5303]

## FIRST GEOMORPHOLOGICAL FIELD SCHOOL

Leningrad, VESTNIK LENINGRADSKOGO UNIVERSITETA: GEOLOGIYA, GEOGRAFIYA in Russian No 6, Issue 1, Mar 84 pp 119-120

SELIVERSTOV, Yu.I.

[Abstract] The First Geomorphological Field School was held in Turkmenia during the period 15-25 September 1983. It was organized jointly by the Geography Institute, USSR Academy of Sciences, and the Seismology Institute, Turkmen Academy of Sciences. It was held for solution of problems formulated by the All-Union Conference on Study of Recent Crustal Movements (1982, Kishinev). The purpose was to upgrade the skills of specialists in studying recent relief-forming processes in geodynamic test areas. The Ashkhabad Geodynamic Test Area, located in the central and southwestern parts of the Kopet-Dag (its mountainous and foothill parts, including the southern margin of the Karakum), was selected as the field work location. The field program included familiarization with methods for defining and field mapping of sectors of active manifestation of recent and ancient seismic dislocations expressed in the relief; familiarization with methods for field instrumental observations of the development of channel, slope and other processes; field morphostructural and in part morphosculptural investigations in different regions of the Kopet-Dag with an evaluation of the role of the most recent and ancient morphostructures in the development of recent relief-forming processes. The first session of the school was a total success. An enormous amount of material was presented with on-the-spot viewing of the geomorphological subjects being discussed. More than 10 field trips were made. Participants were shown the direct relationship between the most recent morphostructures and Cretaceous-Paleogene geological structures; the direct relationship between geological and geomorphological elements; the arched-overthrust nature of Kopet-Dag uplift with a significant role of faults of different direction; the great importance of the lithological factor in relief formation; various erosional relief forms now developing with difficulty due to acceleration of the process of disappearance of glaciers, whereas positive movements will result in persistence of glaciers. The glaciation of the range is not so great and its stability is somewhat threatened by a predominance of negative crustal movements. The climatic prospects for its development in the coming millenium are not encouraging. Plans based on glaciers as a highly important natural resource must therefore be weighed with caution. Figures 4, tables 4; references: 16 Russian.

[255-5303]

# POSSIBILITIES OF AERIAL ELECTRIC PROSPECTING BY LONG CABLE METHOD FOR DETECTING POORLY CONDUCTING STRATA

Leningrad, VESTNIK LENINGRADSKOGO UNIVERSITETA: GEOLOGIYA, GEOGRAFIYA in Russian No 6, Issue 1, Mar 84 (manuscript received 15 Aug 83) pp 19-28

VESHEV, A.V., GUDOVSKIKH, S.S. and LYUBTSEVA, Ye.F.

[Abstract] The long-cable method is being used successfully in solving structural mapping problems in various ore regions in the USSR. In an earlier publication (VOPROSY GEOFIZIKI, No. 29, pp. 53-65, 1982) the authors used modeling in studying the nature of the anomalous field of an alternating current flowing in a cable of finite length for aerial electric prospecting over thick well- and poorly conducting strata at different distances from the cable. On the basis of the results of this earlier work the authors now clarify the possibilities of discriminating poorly conducting strata by this method for solving problems in geological mapping. Expressions are derived for the dependence of the anomalous field of a cable of finite length on observation altitude, depth of the upper surface of the stratum and its thickness. A study was also made of the anomalous field over two poorly conducting strata with different distances between them. The modeling was done with an apparatus described earlier (the principal parameters of the modeling apparatus are given in a table; modeling scales of 1:10,000 and 1:15,000 were used). The results indicate that the method can be employed in identifying bodies with both high and low conductivity. The effectiveness of such work can be considerably improved when measurements are made of the horizontal component of the electric field parallel with the horizontal component of the magnetic field. Figures 3, tables 2; references: 9 Russian.  
[255-5303]

UDC 549.621.9

# LIGHT MICAS OF BOGUTA SCHEELITE STOCKWORK (SOUTHERN KAZAKHSTAN)

Leningrad, VESTNIK LENINGRADSKOGO UNIVERSITETA: GEOLOGIYA, GEOGRAFIYA in Russian No 6, Issue 1, Mar 84 (manuscript received 2 Jun 83) pp 29-33

PANOVA, Ye.G. and VASHCHENOK, V.N.

[Abstract] A study was made of light micas from the Boguta scheelite stockwork located to the northeast of Alma-Ata. The region of this deposit is in the eastern part of the Zailiyskiy anticlinorium and is made up of fine- and medium-grained sandstones and shales. The sedimentary stratum is penetrated by leucocratic granites with mica. The extent of the intrusive body is 1,200 m and the width is 240 m. Rare earth mineralization in the form of veins and veinlets with scheelite is found amidst sericitized sandstones. Within the ore stockwork there are two principal zones and several feathering bodies; three types of veins of different age are distinguished.



Micas of greisenized granites and stockwork micas were studied. The latter are represented by gilbertites, central micas and late fine-sequence sericites. The monomineral fractions of micas were subjected to chemical, spectral, optical, x-ray and thermal study, as well as IR spectroscopy and electron microscopy. The composition of the micas was studied by chemical, flame-photometry and spectral methods (the results are given in a table). Differences were established between the micas of granites and the micas of the rare-metal stockwork. The formation of micas in veins is closely related to the greisenization around the veins. It occurred as a result of the redistribution of sericites from the sandstone enclosing the veins. The composition and properties of the micas changed in the course of development of the stockwork. A change in composition exerts an influence on the parameters of the lattice of micas, the position of the absorption bands of the IR-spectra and the heating curve parameters. Tables 1; references:

10 Russian.

[255-5303]

UDC 550.343.6:550.385.37

#### GEOMAGNETIC PRECURSORS OF INTENSIVE EARTHQUAKES IN THE 1-0.02 Hz FREQUENCY RANGE OF GEOMAGNETIC PULSATIONS

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 24, Jul-Aug 84 (manuscript received 10 Mar 83; after revision 1 Jun 83) pp 697-700

GOGATISHVILI, Ya.M., Geophysics Institute, Georgian Academy of Sciences

[Abstract] During intensive geotectonic processes such as earthquakes, pulsations are observed in the geomagnetic field at a frequency of 0.02-1 Hz with anomalously high amplitudes. These pulsations usually appear as beat phenomena lasting from several minutes to several hours. It has been found that the pulsations are excited only in magnetic components of the terrestrial electromagnetic field. The periods and amplitudes of the pulsations are nonlinearly related to the intensity of the earthquakes. Pulsations of this type are not observed when earthquakes do not occur. Additional analysis shows that frequently the pulsations precede intensive earthquakes by 10-200 minutes, then drop for about 1 hour, then appear once again during the actual earthquake. Oscillograms of such pulsations are presented. The periods and amplitudes of the geomagnetic pulsations preceding earthquakes are found to be linearly related to the magnitude of the earthquakes. A regression equation relating earthquake magnitude to pulsation characteristics is presented. Figures 3; references: 5 Russian.

[99-6508]

## SOLUTION OF DIRECT MAGNETOMETRIC PROBLEM ON SPHERICAL EARTH

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR, SERIYA B: GEOLOGICHESKIYE, KHIMICHESKIYE I BIOLOGICHESKIYE NAUKI in Russian No 5, May 84 (manuscript received 8 Jul 83) pp 11-14

MANUKYAN, A.G. and STAROSTENKO, V.I., Geophysics and Seismology Engineering Institute, Armenian Academy of Sciences, Leninakan; Geophysics Institute, Ukrainian Academy of Sciences, Kiev

[Abstract] It is convenient to formulate magnetic models of the earth's crust on a spherical earth by analogy with the formulation of regional density models, procedures for which were outlined in an earlier article by the authors (DOKL. AN USSR, SER. B, No 5, pp 21-24, 1983). In this article, following the same approach, a solution of the direct problem in magnetometry on a spherical earth is given for all elements of the magnetic field for a three-dimensional model bounded by spherical coordinate surfaces. The origin of the spherical coordinate system is at the center of a spherical earth. The inhomogeneous body examined is a spherical rectangular parallelepiped, a body bounded by stipulated coordinate surfaces. First formulas for the magnetic potential are derived, followed by derivation of expressions for magnetic field strength components. In essence the determinations of gravitational and magnetic effects from a three-dimensional spherical body are reduced to numerical computation of triple integrals, accomplished using Gauss-Legendre quadrature formulas. Different variants of the vector field are considered. The algorithm is intended for formulating magnetic models of large geological structures with the earth's sphericity taken into account. The results given in the earlier article can also be used in solving the problem for homogeneous bodies. This requires a rewriting of the known Poisson expressions relating the magnetic and gravitational potentials in a spherical coordinate system. Then the derived expression for magnetic potential can be differentiated for magnetic field strength components in corresponding directions. Figures 1; references 6: 5 Russian, 1 Western.  
[206-5303]

UDC 550.836:556.342

## DETERMINING DEEP HEAT FLOW AND RATE OF HORIZONTAL PERCOLATION FROM TEMPERATURE MEASUREMENTS IN AQUIFER

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR, SERIYA B: GEOLOGICHESKIYE, KHIMICHESKIYE I BIOLOGICHESKIYE NAUKI in Russian No 5, May 84 (manuscript received 28 Jul 83) pp 14-17

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[Abstract] Anomalous heated sectors are encountered in geothermal systems which include horizontal aquifers and zones of increased fissuring.

Stratum waters, moving through zones of increased fissuring, are heated, mixing with the rising fluid. Withdrawing from such zones, the waters are cooled and impart their heat to the surrounding rocks. In a stationary regime this heat passes through the covering rocks to the surface, distorting the deep heat flow. For this reason geothermal measurements made in aquifers or above them give incorrect information concerning the deep heat flow. Accordingly, the author has developed a method for determining the deep heat flow on the basis of aquifer temperature which is undistorted by the movement of ground water. Formulas are derived for this purpose; the parameters used are the equilibrium temperature which is established at the depth corresponding to the middle of the stratum, the thermal conductivity coefficient for the covering rocks, the heat flow through the bottom of the stratum in the absence of the influence of water movement, temperature of the neutral layer, density, heat capacity, rate of percolation, thickness of the aquifer. The problem is solved by the least squares method. Test computations of the method were made and used in studying a hydrothermal deposit in southern Kamchatka. The proposed method makes it possible, using geothermal measurements in an aquifer, to find the deep heat flow undistorted by convection and to determine the rate of percolation in this stratum. Tables 2; references: 5 Russian.

[206-5303]

UDC 550.34.01+550.834

#### SEISMIC WAVES AND DISPERSION RELATIONS

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR, SERIYA B: GEOLOGICHESKIYE, KHIMICHESKIYE I BIOLOGICHESKIYE NAUKI in Russian No 5, May 84 (manuscript received 5 Jul 83) pp 17-20

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[Abstract] The principal laws of propagation of low-amplitude plane waves in a homogeneous isotropic medium with energy losses are presented. The following concepts can be accepted: the Kramers-Kronig dispersion relations are inapplicable between the attenuation factor  $\eta(\omega)$  and inverse phase velocity  $v^{-1}(\omega)$ ; the true velocity  $c_{\text{true}}$  of signal propagation is not dependent on frequency  $\omega$ ; if the canonical norm of the relaxation kernel does not exceed  $2\xi$ , in order to retrieve the kernel it is sufficient to know the  $x/c_{\text{true}}$  value and the functional dependence  $x\eta(\omega)$ , where  $x$  is distance; the  $c_{\text{true}}$  value can be determined from stipulated  $x$ ,  $\eta(\omega)$  and  $v(\omega)$ ; the structure of the medium and dissipative parameters cannot be identified simultaneously; a change in the form of the causal signal can completely characterize the amplitude or phase Fourier spectrum. The propagation of plane waves in a homogeneous medium with a finite relaxation kernel is described by the Volterra integro-differential equation. However, it is shown that the case most common in seismology cannot be described using the Volterra equation due to the inadequately general formulation of the initial problem. A full description of attenuating waves is possible by examining complex oscillations in a homogeneous medium

with an imaginary relaxation kernel which in a special case can degenerate into the Dirac  $\delta$ -function. Proceeding on this basis, the required solution is found in Fourier transform space. A numerical estimate of  $c_{true}$  can be obtained on the basis of stipulated  $x$ ,  $\eta(\omega)$  and  $v(\omega)$  using a discrete Fourier transform. References: 5 Russian.  
[206-5303]

UDC 550.837.6

CONDITIONS FOR APPLICABILITY OF TIKHONOV-CAGNIARD MODEL FOR INTERPRETING  
MAGNETOTELLURIC SOUNDINGS

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR, SERIYA B: GEOLOGICHESKIYE, KHIMICHESKIYE I BIOLOGICHESKIYE NAUKI in Russian No 5, May 84 (manuscript received 21 Jul 83) pp 29-31

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[Abstract] The magnetotelluric sounding (MTS) method proposed by A.N. Tikhonov is extremely simple. However, the development of the theory of deep MTS required a more complex formulation of the problem, dictated by the nonuniformity of the exciting field. Surface impedance is dependent on the electrical parameters of the earth and on the configuration of the field source. It was long assumed that the class of fields allowing use of the Tikhonov-Cagniard model is limited to fields with quite slow horizontal changes. But it was recently shown that this class of fields can be considerably broadened and a condition for the applicability of the Tikhonov-Cagniard model is not only slowness, but also linearity of horizontal field changes. Moreover, it has been stated that the assumption of a constancy of the coefficients of linear correlations of variations of the magnetic and electric fields at a particular point on the surface is invalid. All this has somewhat clouded the picture with seeming ambiguities and contradictions. These matters are clarified in examples and it is shown that contradiction in fact does not exist and the solution of special problems is not inconsistent with the fundamental Tikhonov-Cagniard model. References 4: 3 Russian, 1 Western.  
[206-5303]



# STRUCTURAL MONITORING OF ORE FORMATION IN TALOVSK DOME-RING STRUCTURE OF KORYAK UPLANDS (KAMCHATKA)

Novosibirsk TIKHOOKEANSKAYA GEOLOGIYA in Russian No 3, May-Jun 84  
(manuscript received 6 May 82) pp 74-81

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[Abstract] The possibility is demonstrated of objective and timely prediction of mineralization by identification of circular structurally significant paragenesis in the Talovsk dome-ring structure to which the ore field belongs. The Talovsk dome-ring structure is located at the intersection of two regional deep faults, with extrusive bodies penetrating around the periphery and andesite composition Miocene-Pliocene lava flows above. Analysis of the geometry of the field of circular fractures observed in the structure, supplemented by structural studies, allows structurally significant paragenesis of a given origin (magmatic ore mineralization) to be distinguished. The radial tectonic dislocations are of decisive magmatic and ore-controlling significance in this area. The types of circular structural heterogeneities which can be read from aerial photographs of the surface represent a given composition of rock and have a distinctive geometric manifestation on the surface of the ore field, allowing timely determination of tectonics and structure of ore fields. Figures 3; references 27: 22 Russian, 5 Western.  
[18-6508]

UDC 551.21:551.79(571.651)

# ANTHROPOGENE VOLCANOES OF EASTERN CHUKOTKA

Novosibirsk TIKHOOKEANSKAYA GEOLOGIYA in Russian No 3, May-Jun 84  
(manuscript received 24 Feb 83) pp 82-86

BELOV, Ye.M., SMYSLOV, S.A. and TALOVA, G.N., All-Union Geology Scientific Research Institute, Leningrad

[Abstract] Descriptions are presented of the Melitveyemskiy, Enmelenskiy and Enmelyuveymskiy late Quaternary volcanoes. These volcanoes, known as the Enmelenskiy group of eastern Chukotka, belong to a single fault within a block. The volcanoes were formed in the Anthropogene, as is indicated by the lava flows covering the flooded portions of valleys and overlapping the first terrace above the flood plain of the Enmelyuveym River. The young effusives of the northeastern USSR significantly expand the area of Anthropogene volcanism known. The formations are probably of mantle origin. Figures 3; references: 3 Russian.  
[18-6508]

## MAGNETIC SUSCEPTIBILITY OF KONI PENINSULA ROCK (SEA OF OKHOTSK)

Novosibirsk TIKHOOKEANSKAYA GEOLOGIYA in Russian No 3, May-Jun 84  
(manuscript received 19 May 83) pp 105-107

KORNEV, O.S., KHOMYAKOV, V.D., SHERMET'YEVA, G.N., Sakhalin Complex Scientific Research Institute, Far Eastern Scientific Center, USSR Academy of Sciences, Novoaleksandrovsk

[Abstract] Studies were made of the magnetic susceptibility of rocks in the effusive sedimentary Triassic and Jurassic system from outcropping on the Koni peninsula and intrusive formations of northwestern, Burgalinsk and southeastern granitoid masses and local masses of dionites along the western shore of Signal Bay. Magnetically active formations of Koni peninsula include all the large intrusive masses and effusives of basic and neutral composition. Since there is a zone of highly magnetic dionites around the periphery of the granitoid masses, the magnetic field of plutons, the apical portion of which is eroded should have circular anomalies in plan. This is confirmed by the presence of such an anomaly above the northwestern mass of the peninsula. Uneroded or slightly eroded intrusives of this type should have anomalies with smaller gradients than the uniformly magnetized plutons. A decrease in magnetic susceptibility is noted for all magmatic rocks which has been quartzized, epidotized or sulfide mineralized. This allows detection of hydrothermally and metasomatically altered zones, which may be reflected in the magnetic field as depressions. Interpretation of the magnetic field of volcanogenic formations is quite complex. Figures 1; references: 2 Russian.  
[18-6508]

## NEW DATA ON STRUCTURE OF MARGINAL HOKKAIDO OCEANIC RISE (PACIFIC OCEAN)

Novosibirsk TIKHOOKEANSKAYA GEOLOGIYA in Russian No 3, May-Jun 84  
(manuscript received 10 May 83) pp 100-103

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[Abstract] The 21st cruise of the research vessel "Pegasus" undertook geological and geophysical observations in an area at the southwest end of the Hokkaido oceanic rise. This rise is a portion of the marginal oceanic ridge separating the Kuril-Kamchatka abyssal trench from the base of the Pacific Ocean depression. Seismic profiling located three seismically expressed layers: the acoustical basement, acoustically nontransparent and acoustically transparent layers. The specifics of seismic data obtained from this area indicates that the upper crust consists of two geologically

and geophysically different areas. The smaller, southwestern area consists of the acoustical basement, complicated with small disjunctive dislocations with vertical movements not exceeding 200 to 300 m in most places. In the northeast portion of the area there is a clear stepped structure of the surface of the acoustical basement resulting from the development of many faults with amplitudes of vertical movement of 300-400 m to 2000 m. The fault zone is clearly seen from the ocean bed extending to the northwest through the oceanic Hokkaido rise and continuing to the axial zone of the Kuril-Kamchatka depression. Figures 2; references 5: 4 Russian, 1 Western. [18-6508]

UDC 551.215

#### SPECIFICS OF DEEP STRUCTURE OF EASTERN KAMCHATKA VOLCANIC BELT

Novosibirsk TIKHOOKEANSKAYA GEOLOGIYA in Russian No 3, May-Jun 84  
(manuscript received 27 May 83) pp 68-75

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[Abstract] A description is presented of the deep structure of the eastern Kamchatka volcanic belt, a discordant structure above the basement which is nonetheless influenced by basement structures. The belt is characterized by a high-gradient gravity field, increasing in the direction of the Pacific Ocean. The magnetic field is sharply differentiated within the belt. There are four groups of volcanoes within the belt differing in structural specifics of the basement and characteristics of the gravitational and magnetic fields, indicating different deep structures. The groups are briefly described. The presence of a number of local maxima correlated with large shield volcanoes apparently reflects the formation in the stage of basalt-andesite-basaltic volcanism of volcanic-tectonic uplifts in the axial portion of the volcanic belt. The formation of large calderas in the stage of acidic volcanism was reflected in the gravity field as a series of local minima of varying intensity. A whole system of faults is distinguished by gravitational and magnetic field specifics. Thus, the volcanoes of the eastern Kamchatka belt are in different structural stages: the southern group and Zhupanovskiye Vostraki-Kronotskiy group in troughs; the Mutnovskiy-Zhupanovskiy group intersects basement structures along the strike, with some rows of volcanoes strictly coordinated with the northwesterly strike of the underlying deposits; the Klyuchevskaya group is near the arch of the uplift in the central Kamchatka depression. All groups are related to the same deep northeasterly strike fault. Figures 3; references: 4 Russian. [18-6508]

## HEAT FLOW ON SOUTHERN SLOPE OF BALTIC SHIELD

Kiev GEOFIZICHESKIY ZHURNAL in Russian Vol 6, No 3, May-Jun 84 (manuscript received 15 Dec 82) pp 31-37

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[Abstract] Earlier available data from geothermal research in the north-western RSFSR (the margin of the Baltic shield and its southern slope) did not provide any clear idea concerning the heat flow in that region. New data have made it possible to clarify this picture. Temperature measurements have been made in a series of boreholes 18 to 700 m deep. The thermal properties of rocks (primarily granites and gneisses) were studied from samples of borehole cores. It was found that over the greater part of the territory (Leningrad and area to the north of the Karelian Isthmus) there are relatively slightly variable heat flows of  $55 \pm 4$  mW/m<sup>2</sup>, with some decrease of the flows to the northwest. In the northern part of Lake Ladoga, however, the heat flow is 75 mW/m<sup>2</sup>. Southward is a region with considerably higher heat flows of  $63 \pm 7$  mW/m<sup>2</sup> (its southern boundary probably lies to the south of the line Novgorod-Pskov). These anomalous (for platform regions) heat flow areas are bounded on the northeast, east and south by heat flow quantities normal for the East European Platform; their mean value is  $41 \pm 5$  mW/m<sup>2</sup>. The discovered heat flow anomaly confirms the existence of a heat field disturbance established earlier on the basis of the geothermal gradient. The anomaly does not extend into Finland. The major heat flow disturbance represents the eastern end of the zone of increased flows encountered in the southern regions of the western margin of the Baltic shield. Figures 1, tables 2; references 11: 10 Russian, 1 Western.

[217-5303]

## THEORY OF MULTIELECTRODE PROBES IN BOREHOLE ELECTROMETRY

Kiev GEOFIZICHESKIY ZHURNAL in Russian Vol 6, No 3, May-Jun 84 (manuscript received 10 Nov 83) pp 45-51

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[Abstract] The problem considered is determination of the electrical state of a system of several conducting bodies, insulated from one another, situated in an inhomogeneous medium with a complex geometry and in an excitation regime with an operative feedback. Excellent procedures have been developed for describing (in analytical or algorithmic form) the composition, structure, state and relationships of the system. The author solves the problem of obtaining numerical results on the basis of a determining



algorithm for the real placement of a deep instrument in a borehole surrounded by an inhomogeneous geological medium with a stipulated geometry and distribution of the conductivities in the rock strata making it up. The complexity of the inhomogeneous medium exerts no influence on the characteristics of the determining algorithm because the model of the medium is concentrated in functional parameters which are precomputed and which enter into the determining algorithm as a matrix of the coefficients of a system of linear algebraic equations. When using the finite differences method in solving the problem it is possible to obtain numerical values of the functional parameters for geological media of virtually any complexity with respect to change in conductivities or resistivities in the entire studied region. A system of finite difference equations is solved for a grid of 50 x 400 points of intersection, followed by solution of a system of linear algebraic equations. A solution of the problem is given in the example of a nine-electrode borehole current system (seven- and three-electrode probes can be considered as special cases). The algorithmic and programmed solution makes it possible to ascertain the desired field distribution. Figures 1; references: 3 Russian. [217-5303]

UDC 550.835

# POSSIBILITIES OF PULSED NEUTRON-NEUTRON LOGGING METHOD UNDER THERMOBARIC CONDITIONS OF PETROLEUM- AND GAS-BEARING SECTIONS IN DNIEPER-DONETS BASIN

Kiev GEOPHIZICHESKIY ZHURNAL in Russian Vol 6, No 3, May-Jun 84 (manuscript received 9 Mar 83) pp 66-69

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[Abstract] In the Ukraine at the present time about 40% of all reconnaissance and exploratory drilling, as well as parametric drilling, is for evaluating promising petroleum and gas horizons lying at depths as great as 5-6 km and much greater depths must be reached. The pulsed neutron-neutron logging (PNNL) method affords considerable possibilities in studying deep deposits. The readings in this method are for the most part dependent on the thermal neutron parameters of the studied collectors, especially on the lifetime of the thermal neutrons ( $\tau_{p1}$ ) in them. The article gives an evaluation of the influence of the thermobaric conditions of rock bedding on its thermal neutron parameter  $\tau_{p1}$ . The averaged dependence of the physical properties of stratum fluids on thermobaric conditions in the Dnieper-Donets basin have been determined. For example, a change in thermobaric conditions in the depth range from 0 to 4 km results in virtually no change in the lifetime of thermal neutrons in water, regardless of its mineralization. With a further increase in depth there is an increase in the value of this parameter. The lifetime of thermal neutrons in stratum petroleum and stratum gas has its distinctive values at different depths. Figures 3 and 4 in the text are graphs showing the lifetime of thermal

neutrons in stratum fluids and the reservoir rocks as a function of bedding depth for the thermobaric conditions prevailing in the basin revealing distinct differences for gas-, petroleum- and water-bearing strata. Figures 4; references: 3 Russian. [217-5303]

UDC 550.838.5

#### GEOMAGNETIC FIELD DYNAMICS

Kiev GEOFIZICHESKIY ZHURNAL in Russian Vol 6, No 3, May-Jun 84 (manuscript received 20 Jun 83) pp 69-73

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[Abstract] Theoretical study of the earth's magnetic field is being held back by a shortage of information on paleostrength. Reliable results of determination of Hancient can be obtained only by a careful study of a geological object, making a determination of the nature of the vector of natural remanent magnetization and the degree of its retention. Clarification of the nature of the geomagnetic field also requires a knowledge of the reversal of its poles. In the laboratory one of the processes of formation of low-temperature chemical remanent magnetization of sedimentary formations was investigated. It was found that the magnetization acquired by iron minerals during their low-temperature synthesis from ion solutions precisely indicates the direction of the magnetic field operative at the time of transpiring of the chemical reactions. There is a close linear correlation between this magnetization and field strength. Many experiments were carried out for studying the nature of natural remanent magnetization of sedimentary rocks in the Ukraine and Moldavia. The nature of the natural remanent magnetization of the weathered crust of crystalline rocks, fossil soils, loesses, clays, siltstones and reddish sandstones was determined. The component of low-temperature chemical remanent magnetization played a major role in the total natural remanent magnetization of both recent and ancient sedimentary rocks. All these rocks have a component of secondary magnetization of viscous origin. Studies were also made to determine the transition layers lying on the boundary of zones of direct and reverse magnetization corresponding to the Matuyama and Brunhes geomagnetic epochs. The trajectories of motion of the virtual geomagnetic poles were determined. Study of the vector of natural remanent magnetization of sedimentary rocks is valuable in solving some problems related to the regime of geomagnetic field generation. Figures 3; references: 5 Russian. [217-5303]

# INTERRELATIONSHIP OF EARTHQUAKE MAGNITUDE AND LITHOSPHERIC-ASTHENOSPHERIC THERMODYNAMIC PARAMETERS IN SEISMICALLY ACTIVE ZONES

Kiev GEOFIZICHESKIY ZHURNAL in Russian Vol 6, No 3, May-Jun 84 (manuscript received 8 Oct 82) pp 73-76

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[Abstract] An analysis of extensive data on earthquakes in such seismically active zones as the Caucasus, Tien Shan and Japanese islands made it possible to develop an energy scale applicable to any seismically active zone (L.I. Tuliani, GEOTEKTONIKA, No 1, pp 115-122, 1982). All earthquakes in the range of magnitudes  $3 \leq M \leq 9$  can be classified into two groups. The first group corresponds to earthquake foci with  $9 \leq M \leq 5$ , temperatures  $125 \leq T \leq 1145$ , seismic wave energy  $1025 \geq E \geq 1020$ ; the second group includes earthquakes with  $5 > M \geq 3$ , focal temperatures  $1150 < T \leq 1900$ , seismic wave energy  $E < 1020$  erg. The coefficient of thermal volume expansion is directly related to temperature, but its increase is nonunique for different magnitudes, doubling from  $M = 9$  to  $M = 3$ . With an increase in temperature  $T$ , the coefficient of thermal volume expansion  $\alpha_v$ , volume deformation  $\epsilon$  and normal effective stresses  $\sigma$  there is a decrease in magnitude  $M$ , seismic wave energy, viscosity, bulk modulus  $G$  and effective shearing stresses  $\tau_{or}$ . Earthquakes in seismically active orogenic regions with magnitudes  $M \geq 5$  characterize the lithosphere; those with magnitudes  $M < 5$  characterize the asthenosphere, magma ducts and chambers. The author applied this conclusion earlier in determining the thickness of the lithosphere and explaining inhomogeneities in structure of the crust and upper mantle in the Caucasus, Northern Tien Shan and Japan (GEOFIZ. ZHURN., 5, No 1, pp 78-81, 1983). Determinations of the bottom of the lithosphere correlated well with other geological and geophysical data. Figures 1; references 8: 6 Russian, 2 Western.

[217-5303]

UDC 550.834

## USE OF GROUP SOURCES FOR SUPPRESSING EXCHANGE WAVES

Kiev GEOFIZICHESKIY ZHURNAL in Russian Vol 6, No 3, May-Jun 84 (manuscript received 5 Nov 80) pp 77-82

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[Abstract] Group sources of seismic waves can be used in attenuating exchange waves because of the differences in the physical processes accompanying the formation of transmitted longitudinal and transverse waves during the propagation of elastic oscillations through an interface with increased velocity. The use of a group source causes a change in the relationship of intensities  $P$  and  $PS$  waves. Whereas in the case of a point



source the PS waves at some distance from the source are more intense than the longitudinal waves, in the case of a group source due to its directional properties the P waves will have a greater intensity than the PS waves. There is accordingly a change in the relationship of the P and PS reflected waves. Due to the attenuation of exchange waves it is easier to trace longitudinal waves on the seismic record. In order to ensure a great difference in the intensity of longitudinal and exchange waves it is necessary to use sources having a high directivity, dependent on the length of the excitation base, whose extent should exceed the wavelength. In the lower half-space such sources form a cylindrical wave bounded on two sides by hemispheres. It is essential to reduce the intensity of the spherical part of the wave field while maintaining a high intensity of radiation in a vertical direction. By appropriate choice of parameters for the group source it is possible to exclude the influence of the spherical parts of the wave field when registering longitudinal reflected waves of the required intensity. As the source it is possible to use the grouping of shots in boreholes with the charges placed in the low-velocity zone at depths of 2-6 m. This is highly effective with adherence to the following conditions: the length of the excitation base must exceed the length of the seismic wave, the distance between point sources should not exceed 0.5 the wavelength and the weight of the elementary charge must be minimum (not more than 0.8 kg). Figures 3; references: 4 Russian.  
[217-5303]

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#### CORRECTING DEPTH LINE ON NONLONGITUDINAL SEISMIC PROFILE

Kiev GEOPHIZICHESKIY ZHURNAL in Russian Vol 6, No 3, May-Jun 84 (manuscript received 20 May 83) pp 83-85

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[Abstract] Longitudinal-nonlongitudinal profiling is universally used in seismic work by the common depth point method in the Dnieper-Donets Depression. The depth section along a nonlongitudinal profile is related to the midline between profiles. There is frequently a considerable time non-closure of reflections in a closed system of profiles. This article examines the legitimacy of such an assignment of a reflection to the midpoint because the work is done under a wide range of geological conditions. The computation scheme is simple. The article examines the problem of finding the displacements  $\Delta L$  of the depth line of a nonlongitudinal profile relative to the midline for a single reflection in a homogeneous isotropic medium. The displacement  $\Delta L$  is influenced by the inclination of the reflecting boundary only across the profiles. It is shown that by knowing the echo depth of the reflecting surface on a longitudinal profile and the slope of this surface across the profiles, as well as the distance between the longitudinal and nonlongitudinal profiles, it is always possible to determine the displacement of the depth line relative to the midline. In making practical computations it is convenient to use grid overlays with isolines. The article illustrates such an overlay constructed for the most



common distance between profiles  $L = 1,000$  m. Similar overlays are easily computed for any distances between profiles. Such an overlay enables an interpreter familiar with the geological conditions in the investigated region to evaluate the feasibility of correcting the depth line of a non-longitudinal profile. In many cases displacement of the depth line relative to the midline between profiles may be 100-150 mg. The overlays provide corrections for displacements for different angles and depths of the reflection boundary. Figures 2.  
[217-5303]

UDC 550.834

#### METHOD FOR PROCESSING BROAD-PROFILE DATA

Kiev GEOFIZICHESKIY ZHURNAL in Russian Vol 6, No 3, May-Jun 84 (manuscript received 23 Nov 82) pp 85-88

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[Abstract] Data from areal observation systems afford a possibility for determining the velocity and geometrical parameters of a medium with known differential characteristics of the time fields (for example, surface gradients of the time field or their components). In the special example of an areal observation system, a so-called "broad profile" system (described by B.I. Bespyatov, et al., PLOSHCHADNYYE SISTEMY SEYSMICHESKIKH NABLYUDENIY, Moscow, Vsesoyuz. n.-i. in-t ekonomiki miner. syr'ya i geologo-razvedochnykh rabot, 1980, 44 pages) this possibility is illustrated for a variant of localized, widely separated excitation and reception bases moving autonomously along the broad profile. The distance between the centers of the bases can be varied in dependence on deep and surface conditions, the anticipated depth of the discontinuity to be studied, resolution of the processing system and other factors, which lessens the requirements on the regularity and geometrical trueness of the observation system. The case examined is a field set-up of three sources and nine detectors with 27 different seismic traces being used in giving the required sections of the time fields. The seismic information from the broad profile is accumulated, yielding adequate statistical material and ensuring a local nature of the investigation. The digital processing procedure, involving three-parameter summation, can be accomplished in a single program module on the basis of an analysis of traces grouped on the basis of different criteria, depending on the specific processing variant. With movement of the set-up along the broad profile a high processing efficiency is attained because the analyzed information applies especially to the successive positions of the source-detector set-up. Figures 1; references: 6 Russian.

[217-5303]

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